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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.

(B. Dunstan, Government Geologist.)

PUBLICATION No. 219.

The Etheridge Goldfield.

(SECOND REPORT ON)

WITH MAP AND 7 PLATES.

BY

WALTER E. CAMERON, B.A. (Cantab.).

ASSISTANT GOVERNMENT GEOLOGIST.

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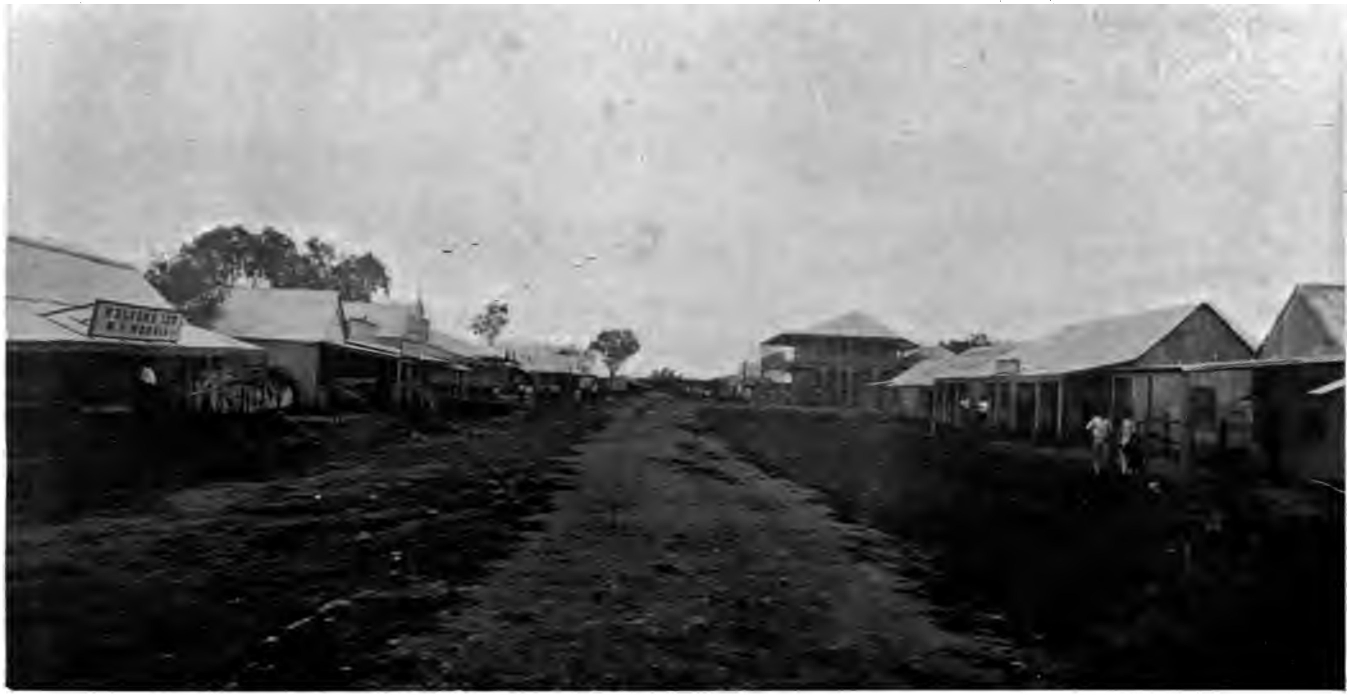

ST. GEORGE STREET, GEORGETOWN.

CAPITAL OF THE ETHERIDGE GOLDFIELD.

THE ETHERIDGE GOLDFIELD.

◆

I.—INTRODUCTION.

The Etheridge Goldfield occupies an area of over 13,000 square miles of the country drained by the Etheridge, Gilbert, and Einasleigh Rivers, the centre of the field being about 200 miles in a direct line south-west of Cairns, with which port it is being now connected by rail. The bulk of the mining on the field has been for gold, and has been confined to that portion of this large area which lies along the head waters of the Etheridge River and its tributaries, the Delaney River, and Sandy Creek. Of recent years the high prices ruling for the industrial metals has led to a certain amount of prospecting of silver-lead and copper shows, but up to the present the output of these metals has been insignificant. A little stream tin was also worked during 1906.

The reefs about the Etheridge and its tributaries are scattered over an area about 30 miles in length by 20 miles in width. The greater portion of the gold output has been derived from about twenty important reefs that have been worked at one time or another on a considerable scale. A very large proportion, however, is the result of crushings from a great number of reefs which have been worked by means of windlass alone, and have been abandoned as soon as the richer surface stone has been exhausted, and the miner has been faced with the problem of contending with water or of doing heavy unremunerative work in order to develop more stone.

The maximum output of reef gold was recorded in 1893, with a return of 29,185 oz. of gold from 25,807 tons of stone. After that year the yield rapidly declined, till in 1900 it stood at 9,694 oz. from 9,801 tons of stone. Since 1900 the return of reef gold has remained fairly constant, with a yearly average of about 9,000 oz. per annum.

The field was last reported* on by an officer of the Geological Survey in 1900, and the main features of the reefs then working were described. A great portion of the gold-bearing quartz of the Etheridge carries a heavy admixture of sulphides of iron, lead, and zinc, which have prevented the economic treatment of the ore by ordinary battery processes, as they entail long and expensive grinding of the minerals to obtain what is at best only an imperfect extraction of the gold. The possibility of dealing more satisfactorily with this difficulty by affording cheap rail transit of the heavy sulphide ores and the concentrates from the mills has recently renewed interest in the field. The prospect of obtaining considerable traffic in this material has, among other considerations, led to the construction of the line now being built from Almaden to Charleston, the latter locality being the centre around which the greater bulk of such material is expected to be obtained.

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* The Etheridge and Gilbert Gold Fields. By. W.E.C. G.S.Q. Publication, No. 151.

II.—PRESENT CONDITION OF MINING.

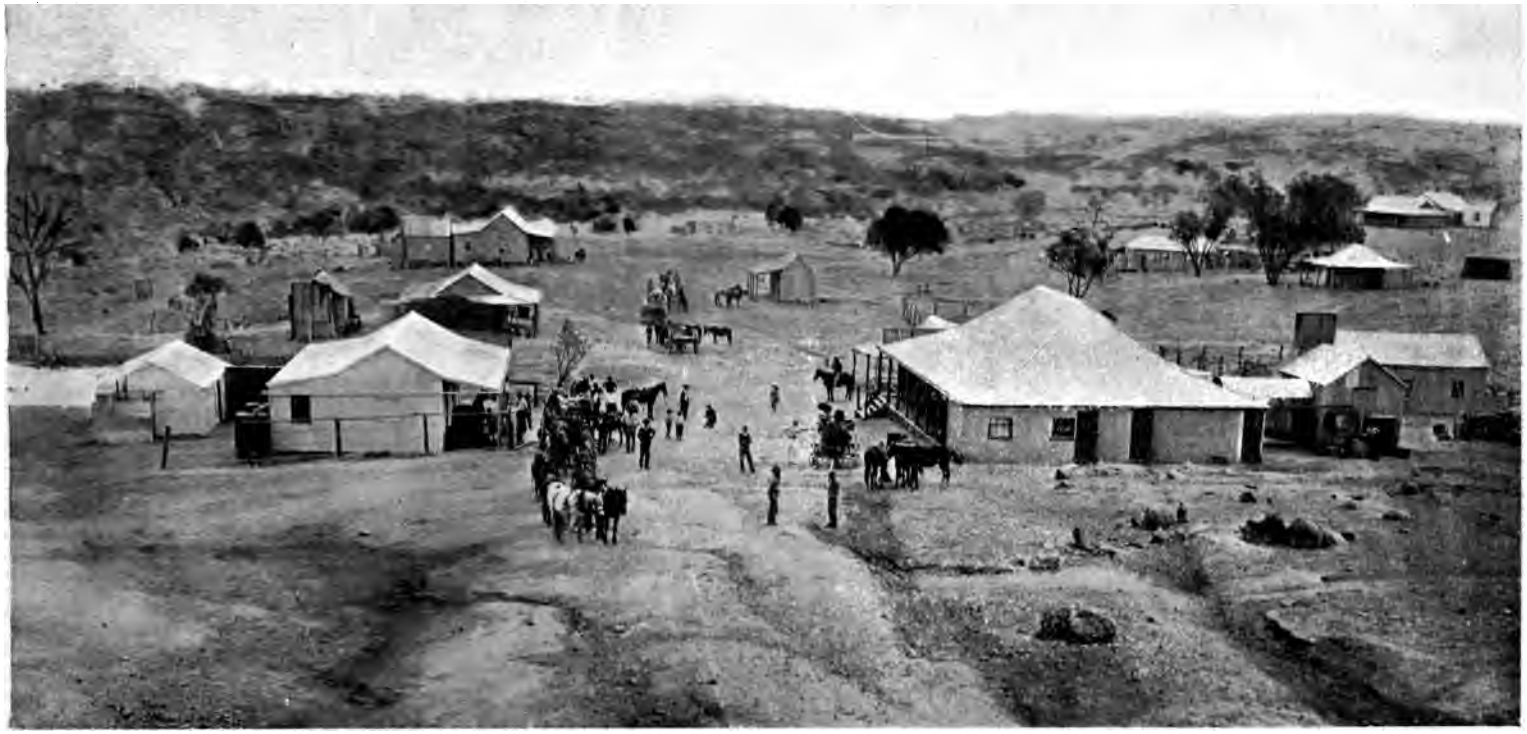
During the eight years that have expired since the field was last reported on by the writer, the only mines that have been worked with any degree of system and success have been the International and Jubilee, in the northern portion of the field, and the Havelock, Queenslander, and Nil Desperandum in the neighbourhood of Charleston, about 25 miles to the south.

The International Mine, situated about five miles south of Georgetown, has been opened out by six levels to a depth of 357 ft. and over a length of about 500 ft. At the time of my last visit it was being worked by a number of shallow shafts, extending to a depth of about 100 ft. only. This reef up to the end of 1907 has crushed some 17,180 tons of stone for a yield of 18,672 oz. of gold. The greater portion of this stone has been lightly mineralised and easily treated.

The Jubilee Mine, at Cumberland, has been worked continuously since 1901, the main shaft having been sunk from the 100-ft. to the 280-ft. level, and about 4,908 tons of stone crushed, a return of 2,038 oz. 7 dwt. of gold, having been recovered by amalgamation. In addition, a considerable amount of gold, of which there is no official record, has been won from the cyanidation of the concentrates and sands.

In the group of mines round Charleston the greatest development has been on the Havelock reef. This reef lies fairly flat, and has been followed down the underlie to about 300 ft. from the outcrop. It has crushed during the last four years some 6,151 tons, for a return of 7,952 oz. 17 dwt. The greater portion of this material has been heavy pyritic stone, which has required expensive grinding of the concentrates for only a partial extraction of the gold. On the Queenslander and Nil Desperandum Mines, which were down 280 ft. and 380 ft. respectively at the time of my visit in 1899, no sinking has since been done, but driving at the lower levels has afforded a considerable amount of additional stone. The results for the eight years ending December, 1907, have been—for the Queenslander, 2,664 tons, for 2,122 oz.; and for the Nil Desperandum Mine, 2,110 tons for 2,079 oz.

Plate II.



TOWNSHIP OF CHARLESTON, ETHERIDGE GOLDFIELD.

TERMINUS OF CHILLAGOE-ETHERIDGE RAILWAY, NOW UNDER CONSTRUCTION.

The following table gives the output of the five more or less regularly producing mines mentioned above, for the years 1900 to 1907:—

Mine.	Quartz Crushed. Tons	cwt.	Yield of Gold. Oz.	dwt.
International	14,621	10	15,063	14
Havelock	7,718	17	9,698	0
Nil Desperandum	2,110	0	2,079	0
Queenslander	2,664	0	2,122	18
Jubilee	4,506	0	1,870	16
	32,620	7	30,834	8

It will thus be seen that only two of the mines on the field have been characterised by any considerable output during the last eight years, and it is patent that the life of the field can be expected to be prolonged only by some distinct reduction in the costs and improvement in the method of mining and treatment, or in the opening up of some yet undiscovered sources of wealth.

The total output of reef gold from the field for the same period is given in the following table:—

OUTPUT OF REEF GOLD FROM ETHERIDGE FIELD, 1900-1908.

Year.	Quartz Crushed. Tons	cwt.	Yield of Gold. Oz.	dwt.
1900	9,801	0	9,693	17
1901	8,087	10	9,042	9
1902	6,776	1	6,682	11
1903	10,430	18	10,229	2
1904	8,746	2	8,735	8
1905	8,315	19	8,346	13
1906	10,547	7	9,788	6
1907	10,575	0	8,828	7
Total	73,279	7	71,346	13

The list of reefs from which crushings are recorded varies yearly from 50 to 100, while the number of which there is any record runs into nearly 200. It will thus be seen that quite one-half of the gold yield of the Etheridge is still obtained from numerous small crushings obtained from a number of reefs scattered over a wide area, and worked in a spasmodic and unsystematic manner.

The cause of the depression of the last ten years on the Etheridge Field has no doubt to be sought for in the exhaustion of the bulk of the easily mined and easily treated shallow stone, but is no doubt to some extent accounted for by the difficulties experienced in dealing with the refractory ores met with below the water level. A contributing cause has also apparently been a noticeable reduction in the gold values of many of the reefs as the deeper levels were reached. This reduction in values, though not so pronounced as to warrant abandonment of further opening up of the lower levels in view of the greater facilities for economical mining offered by the railway nearing completion, has frequently been sufficiently marked to discourage small parties of men struggling against adverse conditions, and hampered by want of capital for proper development and economical working of their mines.

III.—GEOLOGY.

1. The Rock Formations.

The general geological features of the Etheridge rock formations were described in a former report by the author,* and the recent examination, having relation more especially to the mining development of late years, was not sufficiently detailed to add much of interest to those observations. The district offers, however, a wide and almost virgin field for the study of an interesting series of altered sedimentary and intrusive igneous rocks, and their relations to the occurrence of the numerous mineral veins.

The altered sedimentary beds can be best studied along the western margin of the field, their junction with the intrusive rocks running from the southern boundary of the field, near Gilberton, in a northerly direction to near Georgetown, where a tongue of the granite, projecting into them from the west, cuts them off from another area of similar beds about Lane's Creek and the northern portion of the field.

These beds have an almost universal E. and W. strike, and generally high alternating dips. The coarser beds of the series—consisting of massive white quartzites, and representing probably the basal beds of the series—occur in an east and west belt, about eight miles in width, in the bend of the Robertson River. Traced to the north and south they give place to schists and slates, with which are associated numerous mineral veins carrying gold, silver-lead, and copper. At Ortona, on the Percy River, in the south of the field, and Mosquito Creek, near Charleston, the slates and schists are intruded by numerous dykes of diorite, with which the mineral veins appear to be intimately associated.

The granite country occupies the greater portion of the rest of the field, except where it has been displaced by the more recent quartz-porphyries, or where denudation has not proceeded quite far enough to remove the whole thickness of the metamorphic rocks into which it has been intruded. The boundaries between the granite and the metamorphic rocks are irregular, and have not been determined with any attempt at precision. The granite varies considerably in character, but has a prevailing porphyritic character, the porphyritic mineral being of orthoclase felspar, and the crystals being generally present with a regular orientation parallel to a banding of the biotite-bearing ground mass, which appears to have been the result of pressure before the magma had completely consolidated. This banding of the granite and orientation of the felspar phenocrysts (which latter are often as much as 2 in. in length) takes, as a rule, an east and west course (*i.e.*, parallel with the direction of strike of the metamorphic beds), and may possibly have been caused by the same strains which brought about that strike. The most important of the mineral veins occur in the granite country.

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* *Loc. cit.*

The porphyry occurs as a belt some 50 miles in length in a N. and S. direction, and some 20 miles in width at the widest point. Owing to its capacity for resisting weathering agencies, this belt of rocks has not been denuded at as fast a rate as the softer granites and metamorphic beds, and has thus been left as a rampart of ranges dividing the Einasleigh waters from those of the Etheridge and Gilbert. This range, though only standing at a height of about 1,000 ft. above the general level of the country, rises so abruptly from the granite on either side as to greatly hinder communication between the most important portions of the field and the eastern coast. It has caused some difficulties in the surveying of a suitable route for the railway line now under construction from Almaden, though these have now been satisfactorily overcome.

In many places the porphyry stands up at its edge in a wall several hundred feet in height above the granite, into which it sends apophyses that betray its later age.

Several reefs of gold-bearing quartz have been found in the porphyry of the ranges, but they have all been small, and have generally been abandoned after giving a few crushings of rich stone.

2. THE GOLD-QUARTZ REEFS.

The gold-bearing quartz veins occur mainly in the granite formation, though there are numerous examples of their occurrence in the metamorphic beds and in the porphyry. The reefs have a prevailing east and west strike and northerly dip, generally at high angles. This regularity of strike and dip, however, is broken in the northern portion of the field, where the beds take on a more north-easterly to northerly strike.

The reefs occur along simple and comparatively regular fissures, with generally well-defined walls. In a number of cases the walls show evidence of horizontal movement of the hanging-wall and footwall rocks. The regularity of the reefs in strike when followed along any of the levels, and their comparative irregularity in dip, seem to me to point to the same conclusion. In a few cases the vein material appears to be the result of replacement of the crushed and broken rock, torn from the walls as the result of the movement. The wedging out of the different "makes" of stone, and their replacement by fresh "makes" of a different character, incline one to the opinion, however, that much of the quartz has been deposited in open fissures, as it opened from time to time and gave access to the mineral-bearing solutions.

The vein materials vary from almost pure white quartz to nearly pure masses of galena, zincblende, or iron pyrites, while every variety of association of all these minerals is found. A considerable amount of copper pyrites is also present in some of the reefs.

The precious metals are associated more particularly with the minerals, galena, and pyrites, the highly zinciferous ores being generally discarded as too poor to pay for treatment. As a general rule the freer the stone is from galena and pyrites the lower are its contents in gold and silver.

The weathered stone lying within the zone of oxidation, from the surface to water-level, and enriched in gold contents by the decomposition of the metallic sulphides and the carrying away by meteoric waters of the soluble products of their decomposition, has long been practically all treated from the larger reefs. A considerable proportion of the reef returns, however, is still made up of small crushings of "brown stone" from the numerous smaller reefs scattered over this wide area. This "brown stone," from the ease with which the gold could be amalgamated, gave handsome returns to the early pioneers, and it was not till the "mundic stone," or heavily mineralised stone, was struck about the water-level that the difficulties of the field began.

The heavily mineralised belt met with at the water-level has been found to extend down to varying depths, not only in the different reefs but also in different portions of the same reef. It appears, however, in all those reefs that have been opened to any depth to have given place to much less mineralised stone at depths of from 100 ft. to 300 ft. In the International Mine all the heavy galena ore occurred above the 112-ft. level in the main shaft, the lower limit of this ore descending from there to about the 180-ft. level in the No. 1 East International shaft, situated about 720 ft. further east. In the Durham Mine, four miles west of Georgetown, the heavily mineralised and richly gold-bearing stone, which made the mine famous during the years 1888 to 1890, does not appear to have extended much below the 280-ft. level. In the stoping recently done from the new vertical shaft between the 450-ft. and 350-ft. levels only lightly mineralised stone has been struck, the average tenor of which in gold contents has been about 13 dwt. per ton. The average of the heavily mineralised stone recorded for the years 1888 to 1890 was over 2 oz. per ton for 7,816 tons. In the southern portion of the field the replacement in depth of the heavily mineralised stone by more siliceous material is not, perhaps, so noticeable, but in the Queenslander Mine there is evidence that the reef is getting less mineralised below the 180-ft. level. In the Nil Desperandum Mines, also, heavy galena-bearing ores, which were met with between the 180-ft. and 280-ft. levels, give place to lightly mineralised stone below, so that here also there are not wanting indications that the heaviest deposition of mineral does not reach to any great depth below the water-level.

The mines mentioned are the only four, now open for inspection, that have been sunk below the 300-ft. level, but there seems every likelihood that in several other reefs not now being worked the same conditions have been found to exist.

This phenomenon is probably to be explained by the theory of deposition of the minerals of the reef from ascending heated alkaline solutions. Owing to the greater solubility of the metallic sulphides in such solutions, as compared with that of silica, it is natural to suppose that the latter will be carried to higher levels in the fissure before precipitation. The less soluble silica will be deposited in greater quantities with the first lowering of temperature and pressure.

This feature of the Etheridge reefs is not a very promising augury for the permanency of the traffic in concentrates expected for the Etheridge line. There are, of course, at present in sight in the various mines that have been opened out to any extent, considerable quantities of heavily mineralised stone, which will keep the line supplied with this class of freight for some time, and there seems every likelihood that the stimulus given to mining generally by the advent of the railway will lead to the development of numerous other reefs capable of supplying mineral traffic to the railway. In the absence of any evidence of a continuance of these heavily mineralised ores with depth, and with the experience of several of the better developed mines as a guide, it seems advisable that the continuance of a supply of these heavy sulphide ores should be proved by extensive development before any very great hopes are built on the possibilities of their occurrence in large quantities.

As noticed before, there has been a fairly general experience that the richer portions of the reefs are those which carry the greater proportion of the metallic sulphides, especially galena and pyrites. The often sudden decrease in these minerals on passing certain levels has thus in many cases been accompanied by a lessening of gold values in the reef, which has been sufficiently marked to lead to a suspension of mining operations and the abandonment of the mine. In several cases, however, and notably in that of the International Mine at Donnyville, the lightly mineralised stone has been extensively worked in the lower levels, and has given thousands of tons of easily treated material, averaging over an ounce of gold to the ton.

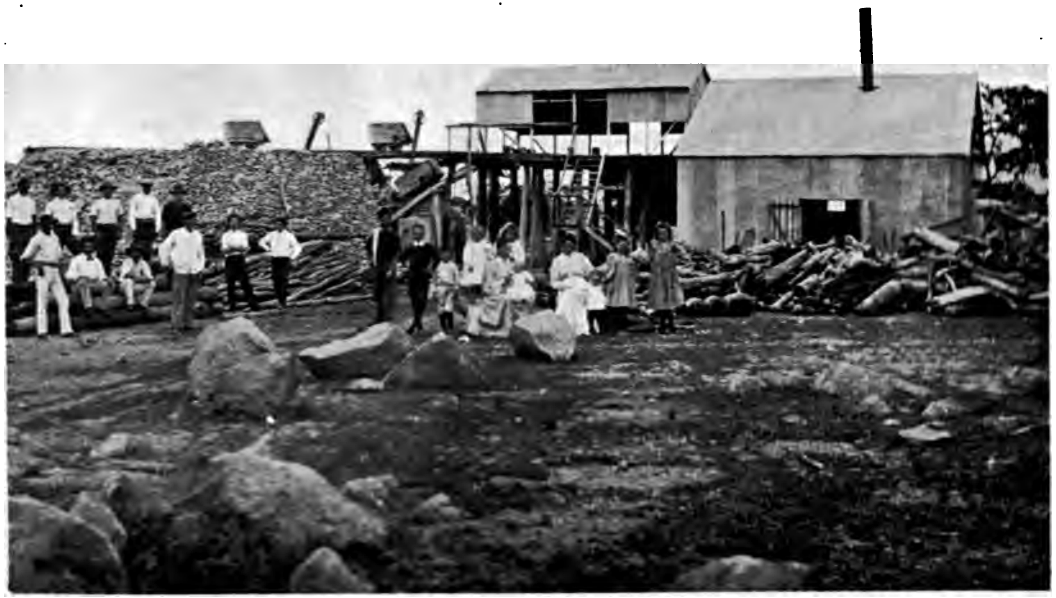
IV.—TREATMENT.

With the majority of the reefs heavily mineralised stone was struck at a depth of from 40 ft. to 60 ft. The difficulties experienced in treating this material led to the introduction of elaborate grinding machinery, in which the concentrates were ground with mercury, and the gold more intimately associated with them was thus freed to some extent and amalgamated. This process, however, besides being expensive, gave a very unsatisfactory extraction, and some method more adapted to the treatment of this refractory material has long been a desideratum on the field. Within the last few years some slight improvement has been made in the treatment by the introduction of Wilfley and Card concentrating tables, and by the postponement of any attempt at amalgamation till the bulk of the gold has been concentrated into a small quantity of the heavier sulphides at the head of these tables. These headings are then amalgamated in Berdan pans, and the middlings and tailings stacked for subsequent treatment. This process has been adopted at the Havelock Mill, at Charleston, crushing stone from the Havelock, Queenslander, and Nil Desperandum Mines, and was suggested by the success of the method at the New Ravenswood Company's Mabel Mill at Ravenswood, treating ores of very much the same character. In the case of the Charleston ores, however, as far as I could learn from the values given as being left in the residues from the Berdan pans and in the seconds from the tables, the percentage of extraction by amalgamation has not been nearly as high as in the case of the Ravenswood ores. A considerable amount of gold still remains to be recovered from these seconds and tailings, which are at present being stacked awaiting the completion of the railway to allow of their being despatched to smelters.

At the Donnyville Mill, treating stone from the International Mine, the recent introduction of a Card concentrator has allowed of the treatment during 1907 of a considerable quantity of heavy galena-bearing ore, from which has been obtained 69 tons of firsts, carrying 60 per cent. lead, with 4 oz. of gold and 14 oz. of silver per ton. The bulk of the stone from the International Mine has, however, been amenable to ordinary battery amalgamation, so that the question of economical treatment has never to any great extent hampered the development of this mine.

At the Cumberland Mill, which has during the last seven years been treating ore raised mainly from the Jubilee Mine, the ore, after crushing, is first concentrated on Wilfley tables and the coarse gold recovered from the concentrates by amalgamation in Berdan pans. Apparently about one-half of the total extraction is thus recovered, and the remaining half by cyanidation of the residues from the Berdan pans and the tailings, to which process the ore from this mine is perfectly amenable, owing to its low contents in copper and zinc compounds.

Plate III.



INTERNATIONAL GOLD MINE, NEAR GEORGETOWN.

BRACE AND ENGINE HOUSE OF MAIN UNDERLIE SHAFT.

V.—GOLD MINES.

THE INTERNATIONAL MINE.

The reef found in this mine has been worked to a depth of 357 ft. over a length of about 500 ft., and the main shaft has been recently sunk on the reef to a depth of 433 ft. The reef strikes east and west in granite country, and dips steeply but irregularly to the north. The walls are well defined, and show marked signs of horizontal movement, giving evidence that the reef has been the result of the filling of a fissure brought about by differential movements of the hanging-wall and foot-wall country in an east and west direction. The defined character of the walls and the irregularity of the vertical cross section of the workings show that there could have been little, if any, vertical movement of the walls on one another. Judging from the amount of stone that has been crushed from these workings, the size of the crushing stuff must have averaged between 1 ft. 6 in. and 2 ft., but in many places the reef has been as much as 5 ft. in width.

Previous to 1899 the reef had been worked from numerous shallow shafts scattered over a length of about 900 ft. along the outcrop, and working mostly oxidised ore to about the 60-ft. level, where the heavy sulphide ores came in. These workings gave, according to the record, about 2,779 tons of stone for a return of 2,866 oz. 2 dwt. of gold, previous to 1899. Since that time the central portion of this line of reef has been developed by the main shaft mentioned above, six levels having been driven at depths of 60 ft., 112 ft., 164 ft., 233 ft., 297 ft., and 357 ft. respectively, the shortest continuous level on the reef being 400 ft. in length. From the 60-ft. to the 112-ft. level in the shaft heavily mineralised stone was met with, but was replaced below the latter level by comparatively lightly mineralised stone, which was carried down to the bottom of the present workings. Most of the stone above the 233-ft. level has already been stoped out and crushed, but there is still a considerable quantity standing in the stopes above the two lower levels in the main shaft. About 700 ft. east of this shaft a second shaft has been sunk, on apparently the same reef, to a depth of about 300 ft. At 180 ft. and 232 ft. levels have been put in west along the reef for distances of about 110 ft., and a considerable block of stone between the two taken out. At this point heavy galena stone was met with in the upper level, this character of stone evidently continuing down to greater depths at this point of the reef. As there was no work going on at this shaft, the workings here could not be inspected.

The International Mine up to the end of 1907 had produced 16,915 tons of stone, from which 17,964 oz. of gold had been extracted.

THE DURHAM MINE.

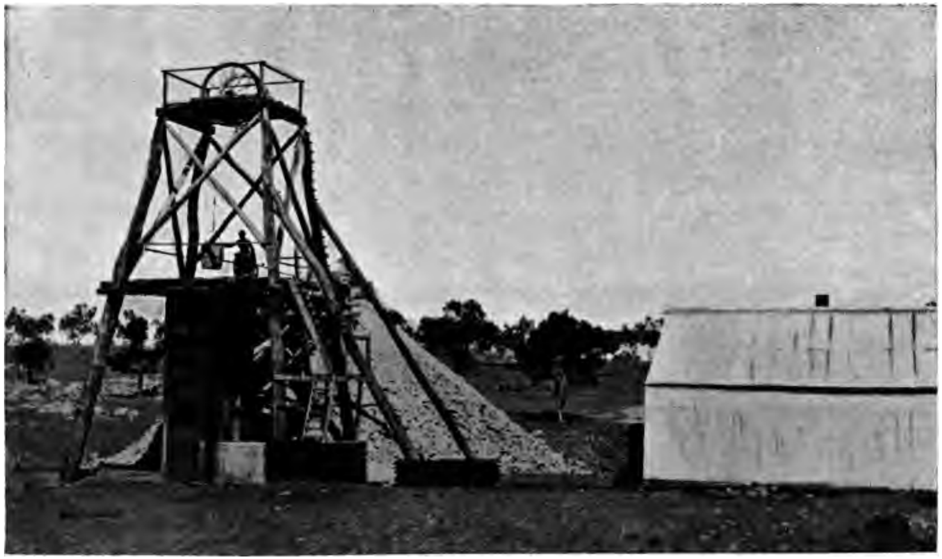
This mine lies about five miles due west of Georgetown, on the Croydon road. During the four years from 1888 to 1891 it is recorded as having given 14,543 oz. of gold from 7,816 tons of stone, but after that date its output declined rapidly, and in 1897 the Warden's annual report states the mine was practically deserted. The mine was worked from two shafts, situated about 700 ft. from each other along the line. The North-eastern (or No. 2) shaft was vertical, and cut the reef (which at this end dipped more flatly than at the south-western end) at a depth of 180 ft. Levels were put in at 182 ft. and 280 ft. to meet those coming from the south-western shaft, where the bulk of the work was being done; but, judging by the plans of the mine now extant, very little stoping was carried out near this shaft.

The bulk of the work was done from the south-western (or No. 1) shaft, which followed the underlie of the reef to beyond the 342-ft. level, and from which the bulk of the stone down to that level, and for a length of about 400 ft. towards the No. 2 shaft, was stoped out. At this point the reef was cut off by a fault, which can be now seen in the 260-ft. level and the three levels below it. This fault shifts the course of the lode some 6 ft. to 10 ft., and up to the present very little stone of value appears to have been met with to the N.E. of it.

The reef was worked by a winze (known as Neil's winze) for about 60 ft. below the 342-ft. level, this winze being about 300 ft. west of the No. 1 shaft, the length of driving from the bottom of the winze having been about 200 ft. This work was done in 1894 and 1895, since which time the mine has been practically abandoned.

During 1907 a new vertical shaft was sunk away from the reef, on the hanging-wall side, between the two old shafts, and at a distance of about 300 ft. from the No. 1 shaft, and a crosscut, put in to the N.W., met the reef, in about 70 ft., at a depth of some 64 ft. below the old workings, and about 450 ft. from the surface. Levels have been driven east and west along the reef struck in this crosscut, and a connection made with Neil's level above. A considerable amount of stoping has been done from these two levels, but, so far, with somewhat disappointing results. The reef exposed in these levels is white in character and low in gold values. About 100 ft. N.E. of the crosscut it is cut off by the crosscourse which was met with in the upper levels, and which throws the reef about 10 ft. or 12 ft. to the S.E. on the N.E. side. Heavy water was met with in the bottom level along this crosscourse, and the levels have not been extended in this direction. At the old No. 2 level (280 ft.) an old winze (about 10 ft. N.E. of the crosscourse) has been cleaned out, and good stone found along the bottom about 50 ft. down. This good material may continue down to the lower levels on the N.E. side of the crosscourse, but otherwise

Plate IV.



THE DURHAM GOLD MINE, NEAR GEORGETOWN.

NEW VERTICAL SHAFT.

the developments have been disappointing. Up to the end of last year 738 tons of stone from the two lowest levels had been crushed, for a return of 501 oz. 4 dwt. of gold.

The Durham Reef occurs in a fissure in granite, showing, as a rule, well-defined but somewhat irregular walls, the reef varying considerably in thickness from point to point, but averaging probably from a foot to eighteen inches.

The heavily mineralised and rich stone worked in the upper levels does not appear to have been found below about the 300-ft. level, where it gave place to the lightly mineralised stone which was disclosed by the recent reopening of the mine, and the average gold contents of which have been under 15 dwt. per ton. The results of this reopening of the mines have proved somewhat disappointing, but the directors have added considerably to the efficiency of the equipment, and are in hopes of making a success of the venture.

THE JUBILEE MINE, CUMBERLAND.

The Jubilee Reef lies about 2½ miles N.W. of Cumberland Township. It strikes nearly north and south in granite country, and dips steeply to the east. A few yards east of the reef there comes to the surface a large boss of porphyry, from which tongues of the same rock have been sent off into the surrounding granite. No less than three of these tongues of porphyry, from five to thirty feet in thickness, have been passed through in sinking the main shaft, and can be traced through the stopes from the fact that the reef fissure is much narrower in the porphyry than in the granite, and, as a rule, contains no quartz, or only a thin seam. The intrusion of the granite by the porphyry was evidently antecedent to the formation of the reef fissure, which can be traced right through both granite and porphyry bars. These porphyry bars were struck at depths of 80 ft., 200 ft., and 280 ft. respectively in the main shaft, and the plan of the workings show them dipping to the north, in parallel fashion, at an angle of, roughly, 35 degrees from the horizontal.

The quartz of the reef appears to be a replacement of the granite walls along either side of the fissure. Where the fissure crosses the bars of porphyry, however, no such replacement of the walls has taken place, owing, probably, to the more compact and more finely-grained nature of the rock not allowing of the permeation and alteration by siliceous mineral-bearing solutions which has occurred where the walls of the fissure have been of granite.

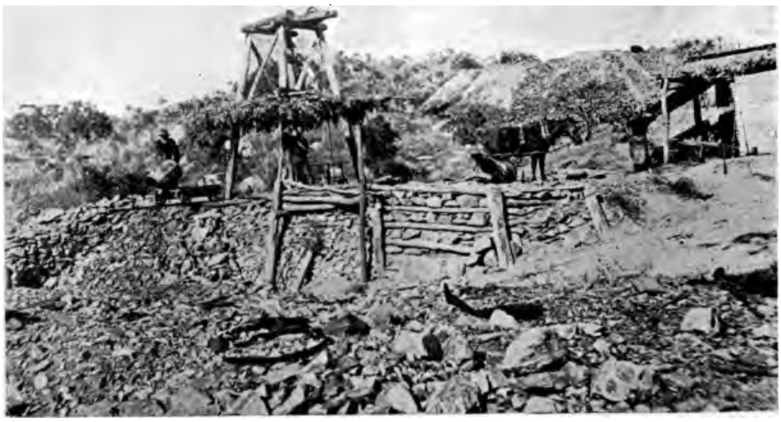
The reef varies considerably in thickness, in places pinching out entirely and again making to 9 ft. in width, with horses of granite, which have not been replaced by quartz. Down to the 280-ft. level the reef had yielded up to the end of 1907 about 4,764 tons of stone, for a return of 2,947 oz. of amalgamated gold. The recorded returns from the mine date from 1887. From 1896 to 1901 the mine was deserted, most of the stone above the 100-ft. level having been worked out previous to that date. Since 1901 the material from the mine has been treated by concentrating the crushed stone on Wilfley tables and amalgamating the concentrates in Berdan pans. The tailings are cyanided, and account for a large percentage of the total recovery; so that the reported returns from the battery treatment are no indication of the value of the stone.

The intrusion of the porphyry bars, besides rendering a considerable quantity of the ground barren, has added greatly to the expense and uncertainty of the mining operations, which have also been somewhat hampered by a bad hanging-wall to the reef. The suitability of the ore, however, for amalgamation and cyanide treatment has allowed of a better percentage of extraction of the gold than is possible with most of the Etheridge reefs.

THE HAVELOCK MINE.

The Havelock is a flat reef, lying about five miles south of Charleston, on the Castleton road. It strikes east and west, and dips at an angle of about 33° to the north. The reef has been worked for a length of about 400 ft. along the outcrop, but is now being operated from a vertical shaft, 90 ft. in depth (which meets the reef about 180 ft. from the outcrop), and an incline going down about 140 ft. below the bottom of the straight shaft. To the west of the vertical shaft the reef splits into a hanging-wall and footwall vein, and has only been driven on a few feet at 40 ft. and 110 ft. respectively below the bottom of the straight. Very little stone has been taken out on this side of the shaft. The levels at the above depths have, however, been driven 270 ft. and 155 ft. respectively towards the east, and a large amount of stoping has been done in the sulphide ores on this side of the shaft. From the upper level (40 ft. below the straight) the reef has all been stoped out for 260 ft. up to the old workings 70 ft. above, the end of the drive showing about 4 ft. of reef. From the lower level the stone has been stoped up for about 110 ft. in, and the end of the drive shows about 3 ft. of reef. In the end of the stope between the two levels the reef is 7 ft. in width. From these workings to the east of the underlie about 6,150 tons of stone have been stoped since the beginning of 1904, for a return of 7,951 oz. of gold. Till the end of 1907 the total quantity of gold won down to about 300 ft. from the outcrop has been 11,568 oz. 12 dwt. 17 gr. from about 10,095 tons of stone.

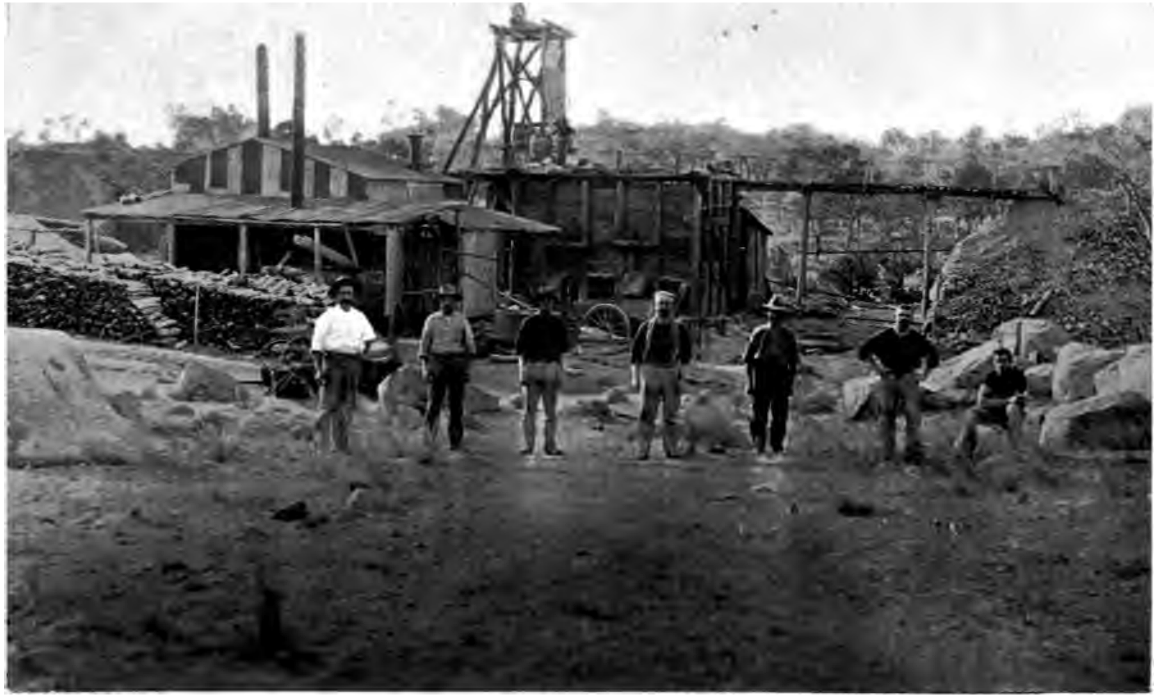
Plate V.



HAVELOCK GOLD MINE, CHARLESTON.

HORSE GEAR ON VERTICAL SHAFT.

Plate VI.



QUEENSLANDER GOLD MINE, CHARLESTON.

MAIN UNDERLIE SHAFT.

The sulphide mineral of the Havelock Reef down to the present bottom of the mine consists mainly of iron pyrites. This ore gives only a very imperfect extraction with the processes employed at the Havelock Mill, the gold being so intimately associated with the pyrites as to be amalgamable only with the greatest difficulty. The residues and seconds from this reef are accordingly reported to be very rich, though I was unable to get any figures as to the values they contain.

THE QUEENSLANDER MINE.

This mine is situated about two miles due west of the Nil Desperandum Mine, on a reef dipping steeply to the north. The main workings extend for about 540 ft. along the reef down to the 180-ft. level, practically all the stone from this block having been worked out. The shaft is down to a level at 280 ft., from which level a block of ground was stoped for about 250 ft. east of the shaft when the mine was closed down in 1903. Up to that time the main workings had given about 13,115 tons of stone, of an average value of about £4 per ton. This indicates an average thickness of reef of about 17 inches.

The mine was reopened in 1904. The bottom level (280 ft.), which was in 120 ft., had been stopped in poor stone, but a few feet of driving obtained good material again, and the level has since been taken in to 420 ft., and the stone stoped up for about 20 ft., showing a reef averaging about 2 ft. in width, from which about 500 tons of stone have been crushed since 1904, for a return of about 16 dwt. per ton.

In the drive to the east at the 280-ft. level the reef, about 20 ft. from the shaft, split up into thin veins, which were followed in a drive for about 400 ft. A new make of quartz was struck about 200 ft. in, and was followed to the face, where it is about 2 ft. 6 in. in width. The value of this stone is estimated to be about 10 dwt. per ton. At the end (*i.e.*, 400 ft. from the shaft), this level is connected by a winze with the 180-ft. level above.

The 180-ft. level has been lately continued in past this winze. It passed through poor stone beyond the old stopes, 140 ft. in., to the 350-ft. point, where heavy galena ore was struck, and followed to nearly the 600-ft. level, showing a shoot of about 250 ft. of this class of stone, the face still showing 2 ft. 6 in. to 3 ft. of heavy galena ore. This ore has been stoped up to about 40 ft., the top of the stope being connected with the surface through the No. 1 West shaft, about 460 ft. west of the main working shaft. This shoot of stone has not as yet been met with in the No, 3 (280-ft.) level, which requires driving to prospect it at a depth. It seems likely that a considerable quantity of galena ore will be obtained from this shoot of stone as soon as the advent of the railway allows of its being economically treated.

THE NIL DESPERANDUM MINE.

The reef in this mine strikes about east and west in granite country, underlying steeply to the north. The main shoot of ore has been worked for about 500 ft. of its length down to the 380-ft. level by means of an incline shaft near the western end. The continuation of the outcrop can be traced for another 800 ft. east of the main shoot by the position of several shallow shafts, all now abandoned. From Boy's shaft, situated 340 ft. east of the main shaft, a considerable quantity of ground has been worked out to the 160-ft. level, but it is now inaccessible. In the main workings the reef varies very rapidly in thickness, bulging in places to as much as 6 ft. in width, and in others pinching to a thin seam of an inch or two. The average width of the reef over the 500 ft. of shoot worked out to the 380-ft. level has been about 9 in., as far as can be judged by the amount of stone that has come out of the mine. The average recovered value of this stone has been about £4 12s. per ton. Most of this stone was obtained from above the 280-ft. level before the year 1900, when the mine was closed down and allowed to become full of water, the sink from the 280 to the 380 ft. level having proved disappointing. In 1904 the mine was reopened, and the reef driven on at the 380-ft. level for a length of about 230 ft. About 2,078 tons of stone have been obtained since 1905 from above this level and from the ground left standing above the 280-ft. level, but the quality of the material has not been as good as formerly, having averaged under £3 per ton.

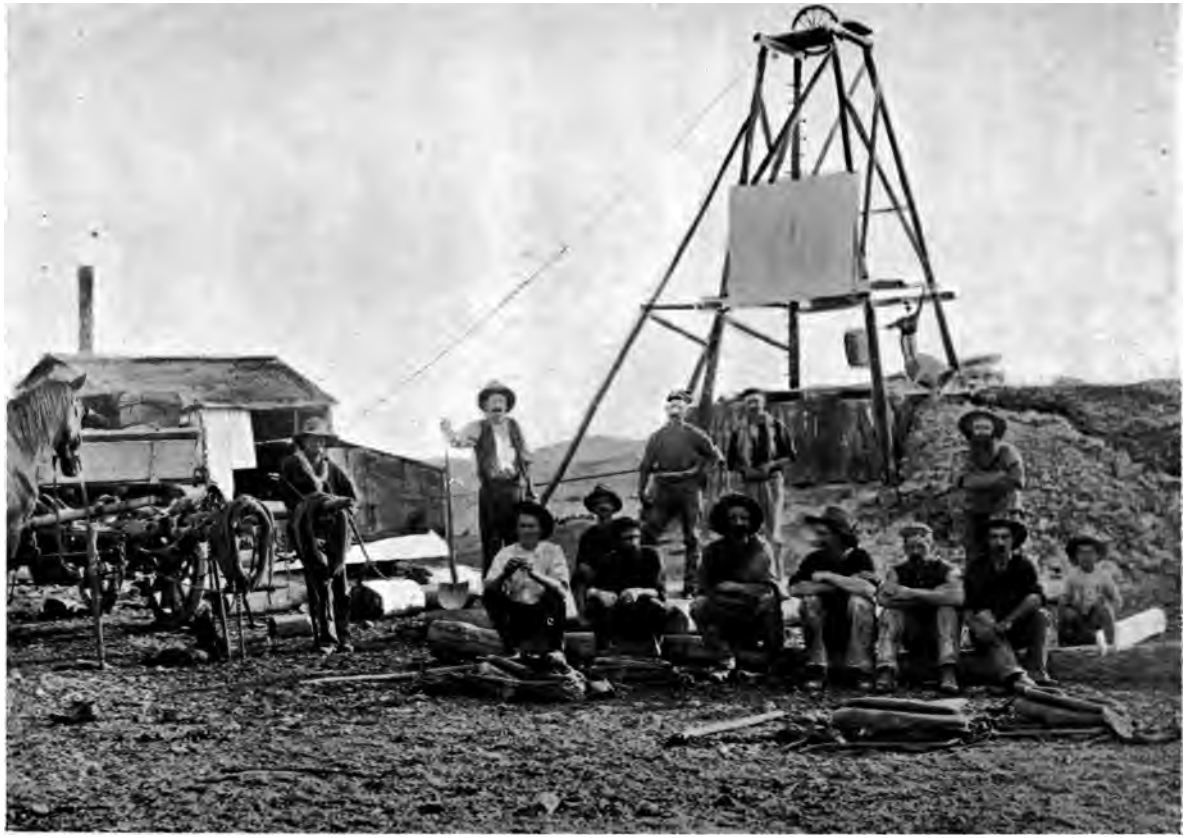
A great deal of the stone in this mine is heavily mineralised with galena, much of it being sufficiently heavy and valuable to allow of its being forwarded direct to the smelters.

VI.—SILVER-LEAD MINES.

MOSQUITO CREEK SILVER-LEAD LODES.

At the heads of Mosquito Creek a number of galena lodes have been taken up within the last two years, and a few tons of rich silver-bearing galena ore have been despatched by team to Croydon for Southern smelters. According to the Warden's report for 1907, some 96 tons of ore were sent away during the year, and gave returns averaging 61 per cent. of lead and 67 oz. of silver to the ton, thus showing over an ounce of silver to the unit of lead. The bulk of this ore came from the Orion Lease,

Plate VII.



NIL DESPERANDUM GOLD MINE, CHARLESTON.

Up to the present no large bodies of ore have been discovered, and development work has been confined to a few shallow shafts on the most promising of the outcrops. The deepest shaft is on the Orion Lease, 100 ft. in depth, further sinking having been delayed till the advent of the railway and the consequent cheapening of mining costs.

At the time of my visit very little was being done on any of the lodes, for the same reason.

Geology.—The country about Mosquito Creek consists of slates, quartzites, and schists, striking generally east and west, and dipping steeply to the north. The veins of galena occur for the most part along the bedding planes of the slates, but here and there break across them at acute angles, and run along what are apparently joint planes. The diorites occur as bars, running for the most part with the bedding of the slates, and show a certain degree of schistosity in an east and west direction, as if they had been subjected to the same pressures which tilted up the slates while still in a plastic condition.

Several of the lodes in this district were worked to a small extent some years ago, the positions of those of the Orion and Southern Cross being shown on a map of the field made by T. R. Geraghty in 1889. The remains of a primitive shaft furnace, and of a reverberatory furnace made of slabs of slate, are still to be seen on the banks of Mosquito Creek. The following is an account of the recent work on these lodes:—

On the *Orion Lease* a shaft has been sunk, following the dip of the lode, to a level at 73 ft. The level was put in east for 30 ft., and the ore overhead stoped out to the surface. Westward the level followed good ore to about 21 ft., thus proving, with the eastern level and the length of the shaft (9 ft.), a shoot of ore about 60 ft. in length. The ore has all been stoped out along this length to the 73-ft. level. Water was standing in the shaft below the level, but a vein of galena, about 15 in. in thickness, is visible on the hanging-wall of the lode, just below the level in the shaft. The total depth of the shaft is given as 100 ft. At the time of my visit the western level was being driven to meet a winze from the surface, about 66 ft. west of the shaft, and was in about 46 ft. The face showed about 3 ft. of slaty formation, carrying a little gossan, and lying between well-defined walls showing signs of movement. There was a thin vein of galena, about ¼-inch in thickness, on the hanging-wall of the formation. This lease is reported to have given about 200 tons of galena ore, averaging 70 per cent. of lead and an ounce of silver to each unit of lead.

On the *Commonwealth* lode a shaft has been sunk on a narrow vein of galena, striking east and west with the slates, and dipping steeply to the north, to a depth of 37 ft. The galena is accompanied by a little ferruginous gossany material in places, but generally occurs as a fairly pure seam along the bedding plane of the slates, running up to 6 inches in thickness. There had been despatched from this shaft 5 tons 12 cwt. 3 qr. of ore, for a return of 350 oz. of silver and 3 tons 14 cwt. 1 qr. 8 lb. of lead. Another 20 tons of seconds, estimated to carry 20% of lead and 20 oz. of silver, were stacked on the surface.

On the *Commonwealth Extended No. 1 West* Lode two shafts have been sunk, about 90 ft. apart, and lying E.N.E. and W.S.W. of each other, the westernmost being 20 ft. and the easternmost 12 ft. deep, and the strike of the slates here being N.W. and S.E., so that the vein apparently lies in a fissure cutting across the strike of the slates. About 10 tons of galena had been obtained from these two shafts, the vein making to about 6 inches in places.

The *Southern Cross* lode crops out in the bed of Sawpit Creek, about 20 chains north of the Commonwealth line, and runs parallel to it in an easterly direction. Old workings, now fallen in, are seen about a chain away from the eastern side of the creek, and a shaft has been recently sunk on a gossany outcrop about a chain further east along the line, but without meeting with anything of value. About 10 tons of galena ore are reported to have been obtained by trenching on the outcrop in the bed of the creek.

The *Argent King* line is situated about a mile north of the Orion. A shaft has been sunk here about 60 ft. to the water-level in graphite slates on a thin vein of galena striking with the slates. Three tons 7 cwt. 1 qr. 8 lb. of galena are reported to have been obtained from the sinking, and to have given a return of 1 ton 13 cwt. of lead and 45 oz. 6 dwt. of silver. Drives have been put in a few feet to east and west, but no ore was visible in them.

The *Pleiades* line of lode lies about three miles west-by-north of the Orion, near the junction of Argent King Creek with Mosquito Creek. On lease 71 a shaft has been sunk to a depth of 60 ft., on a gossany formation carrying a little galena, lying between fairly well defined walls of slate from 3 ft. to 5 ft. apart. The gossan can be traced here and there on the surface into lease 69, where a strong quartz and gossan outcrop, some three or four feet in width and carrying galena through it, stands out on the bank of a gully which cuts across the strike of the lode.

The *Crow's Nest* lode is about 2½ miles N.N.E. of the Orion. It was originally worked as a gold show by means of an inclined shaft, about 80 ft. in depth, sunk on the eastern face of a hill overlooking the main head of Mosquito Creek. The shaft afterwards fell in, but the present owners, on commencing to clean out the shaft, found a seam of galena ore, up to 6 in. in thickness, between the hanging-wall and the quartz reef formerly worked. At the time of my visit they were still putting the shaft in order and erecting a whip to deal with the mullock. A few bags of high-grade galena ore had already been obtained from the old stopes.

Besides the above-mentioned lodes, a few others of less importance have been prospected in a desultory way, but without any important results. With the advent of railway communication it is probable that a fair quantity of rich galena ore will be shipped to the smelters at Chillagoe, and there is some prospect that a few of the lodes will open out as they are sunk on into important lodes of ore.

At present the high costs of carriage to the head of the rail at Croydon (in some cases as much as £9 per ton) have delayed energetic prospecting and development of any of the lodes. The following figures, taken from Warden Hishon's Report for 1907, show the amount and value of the silver-lead ore despatched from the lodes mentioned for that year:—

—	Ore Treated.				Silver.		Value.			Lead.				Value.	
	Tons	cwt.	qr.	lb.	Oz.	dwt.	£	s.	d.	Tons	cwt.	qr.	lb.	£	s.
Orion Mine	87	0	0	0	6,027	0	678	0	9	60	11	0	13	1,074	1
Commonwealth Mine	5	12	3	0	350	0	39	7	6	3	14	1	8	64	1
Argent King Mine ...	3	7	1	3	45	6	5	12	0	1	13	0	0	29	1
	96	0	0	8	6,422	6	723	0	3	65	18	1	21	1,167	3

VII.—COPPER MINES.

1. The Ortona Copper Mines.

These mines lie along the southern bank of the Percy River, about five miles above its junction with the Gilbert. Six lodes have been exploited to the water-level by means of shafts and levels, while in one case sinking, by means of an engine and bailing tank, has been carried down below the water-level.

The country consists of diorites intruding slates, the lodes occurring above the water-level as gossany carbonates and tile ore associated with quartz, and the wall rocks of the lodes being mainly diorite. The diorite shows a marked schistosity in a N.E. and S.W. direction, which corresponds with the bedding of the slates, the lodes running parallel to each other and to this direction.

The lodes were found about the year 1899 by two prospectors—Scarden and Smythe—who got out a few tons of ore and then disposed of the mine to the present owner (John Moffatt and Co.). Since 1899 about 145 tons of rich glance and carbonate ores have been despatched to smelters, and have returned from 30 to 40 per cent. of copper and 3 to 6 oz. silver per ton. In addition, the following amounts and values of ore, according to the estimates of the manager, were stacked at the mine ready for treatment as soon as the reverberatory furnace should be completed:—

I.—BAGGING ORE.

No. 1 Lode	15 tons	carrying	25 %	copper and	60 oz. silver per ton
No. 2 Lode	40 ,,	,,	32 %	,,	6 ,, ,, ,,
No. 6 Lode	5 ,,	,,	33·5 %	,,	6 ,, ,, ,,
	60 ,,				

II.—FIRSTS.

No. 1 Lode	150 tons	carrying	15 %	copper	65 oz. 5 dwt.
No. 2 Lode	350 ,,	,,	16·57 %	,,	6 ,, 10 ,,
No. 3 Lode	150 ,,	,,	12·60 %	,,	7 ,, 10 ,,
No. 5 Lode	165 ,,	,,	10·80 %	,,	1 ,, 12 ,,
No. 6 Lode	850 ,,	,,	15·60 %	,,	3 ,, 18 ,,
No. 2 West Lode	200 ,,	,,	11·80 %	,,	4 ,, 0 ,,
	1,865 ,,				

III.—SECONDS.

No. 1 Lode	200 tons	carrying	6 %	copper	30 oz. silver per ton
No. 2 Lode	220 ,,	,,	3 %	,,	
	420 ,,				

On the *No. 1 Lode* the main shaft has been sunk a depth of 120 ft., and levels driven N.E. and S.W. at the 50 ft. and 100 ft. levels respectively. The workings were full of water below the 50-ft. level. The 50-ft. level had been driven N.E. 133 ft., and connected with the surface by a monkey shaft at 120 ft. in. To the S.W. the level had been driven a distance of 255 ft., and connected with the surface at 155 ft. in. The 100-ft. level had been driven 31 ft. to the N.E. and 48 ft. to the S.W. The average width of the lode has been about 1 ft. in thickness.

On the *No. 2 Lode* a shaft has been sunk to a depth of 165 ft., dipping steeply to the N.W., and levels driven at 65 ft., below which there was water in the shaft. The N.E. level had been driven 85 ft., and the western level 100 ft. The lode has averaged about 2 ft. 6 in. in thickness.

On the *No. 3 Lode* a shaft has been sunk to 60 ft., and levels driven 59 ft. S.W. and 55 ft. N.E., the lode having averaged about 2 ft. in thickness.

On the *No. 4 Lode* a shallow cutting showed about 18 inches of carbonate ore, but no work of much consequence had been done on it.

On the *No. 5 Lode* a shaft had been sunk a depth of 70 ft. in oxidised ores, and levels driven 10 ft. N.E. and 35 ft. S.W., the lode having averaged about 3 ft. in thickness.

On the *No. 6 Lode* a shaft has been sunk a depth of 150 ft., and levels driven N.E. and S.W. at 104 ft. The N.E. level had been driven 36 ft. To the S.W. the lode split in two a hanging-wall and footwall portion, the former being followed for 140 ft., and the latter for 106 ft. Ninety-five tons of bagging ore, averaging 33·5 per cent. of copper and 6 oz. of silver per ton, have been shipped from this mine, and, as shown by the above table, a considerable tonnage of good smelting ores lie stacked at the mine.

On the *No. 2 West Lode* a shaft has been sunk to the 130-ft. level, and drives put in for 41 ft. east and 70 ft. west. About 200 tons of ore, of the value shown in the above table, had been obtained from this work, and from a bit of open-cutting on the lode, about 60 ft. in length and 18 ft. deep, to the west of the shaft.

It would be impossible to form any opinion of value as to the possibilities of these mines without a much more detailed examination than I was able to give them. Judging by the results of assays reported by the manager, however, they would seem to offer good prospects of turning out successfully if the difficulties caused by their isolated position do not prove too great a handicap for them.

2. THE EINASLEIGH COPPER MINE.

Although a very large sum of money has been spent on this mine, it is still in the prospecting stage. About 3,000 tons of oxidised ores are estimated to have been taken from the open-cut on the outcrops upon the bank of the Einasleigh River. About 861 tons of this are reported to have been smelted for a return of 12·9% copper and 2 oz. silver and 3 dwt. of gold per ton, but smelting proved impossible, owing to the difficulties and expense of obtaining coke and fluxes. A main shaft has now been sunk to the 204-ft. level, and crosscuts put in to meet the lode at the 170 ft. and 204 ft. At the 204-ft. level a considerable width of greywackes, impregnated with copper pyrites, was met at two points, distant some 60 ft. apart, but I was unable to learn what were the values of the lode at these points. The mine is now being systematically developed in the sulphide zone, and is expected to furnish traffic to the railway line for many years.

Brisbane, June, 1908.

By Authority: ANTHONY JAMES CUMMING, Government Printer, Brisbane.

Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

PUBLICATION NO. 198.

GOLD, PLATINUM, TINSTONE, AND MONAZITE

IN

THE BEACH SANDS ON THE SOUTH COAST,

QUEENSLAND.

With Appendixes on the Beach Sands of New South Wales, and on the Physical Properties, Sources, and Uses of Platinum.

(WITH 2 PLATES AND 3 FIGURES.)

By LIONEL C. BALL, B.E.,

ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1905.

The results thus far obtained indicate this to be a very favourable field for a dredger. The matter should, however, before installation of expensive plant, be put beyond doubt by a thorough prospcting by boring. The contents might be ascertained by putting down bores, 100 feet apart, over the whole area, but a preliminary test might be made with one bore to every ten acres.

Mr. Joseph E. Carne, F.G.S., Geological Survey of N.S.W.* has briefly described and illustrated sludgers used in prospecting in New South Wales. (Fig. 3.)

Those made locally consist of a section of gaspipe, tempered and fitted with two rectangular opposite openings near the upper end, and a perforated wooden plug valve and metal dump. Lining tubes for the sludger holes consist of two lengths of gaspipe or ordinary galvanised spouting of a slightly larger diameter than the sludger barrel. A chisel-shaped cutter might be affixed to the upper end of the sludger rod to facilitate passage through hard bars. The sludger rod is of light pine, and 16 feet to 18 feet in length.

An improved sludger, designed by Mr. R. W. Laidley, of Sydney, consists of a short steel barrel, about 2 feet long and 1½ to 2 inches in diameter, fitted with an air-tube and spring dump, or a ball and clack valve.

The sludger is worked like a jumping rod, the fall of the tool being followed by a semi-rotary boring motion. In prospecting with the machine a hole is sunk 3 feet deep, in which a man can stand and gradually press the lining tube down with a semi-rotary motion. When two lengths of lining tube are used the shorter is first put down to the level of the 3-feet hole, and then withdrawn by means of a rope, and the longer inserted, this procedure obviating the erection of a raised platform.

The simpler sludger first described has been tried at Currumbin, and is found to work satisfactorily in dry sand, though it is almost as quick to sink by shovel down to depths of 14 feet. It, however, failed entirely when the sand contained water. For such ground it will, therefore, be necessary to affix a rough clack-valve to the interior of the bottom of the cutting pipe. This will open to allow the sand and water to enter, but fall back, retaining the material as the sludger is raised.

Special experiments will have to be carried out to determine some method of saving the valuable minerals—the gold, platinum, tinstone, and monazite; for, as already mentioned, their extreme fineness has caused much trouble in separating them from the heavy black sands. Magnetic separation should give good results as far as

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* Annual Report of Department of Mines and Agriculture, N.S.W., for 1895, p. 158.

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GOLD, PLATINUM, TINSTONE, AND MONAZITE IN THE BEACH SANDS ON THE SOUTH COAST OF QUEENSLAND.*

INTRODUCTION.

In May last a sample of brown concentrates from the auriferous sands of the South Coast was delivered at the Geological Survey Office for examination as to the presence of platinum.

A number of minute flattened grains of a white lustrous metal were obtained by carefully panning off the accompanying minerals. These grains were dissolved in *aqua regia;* the solution was evaporated to dryness, and the salt remaining was then dissolved in water. The addition of potassium iodide caused the formation of a deep rose colouration, proving the presence of platinum.

The concentrates consist chiefly of well-rounded grains, though a few prismatic crystals are also to be seen. The grains are red-brown and honey yellow (tinstone and monazite), white (zircon, topaz, and quartz), black (magnetite and ilmenite), and greenish (tourmaline).

The presence of phosphates (monazite) was proved by heating the powdered material with a drop of sulphuric acid, and to the dried residue adding ammonium molybdate with excess of nitric acid, when, on evaporation the yellow colour of ammonium phospho-molybdate was obtained.

The Government Analyst found the same sample to contain 4.3 per cent. of the cerium group of earths (calculated as oxides, and including 0.4 per cent. thoria) together with phosphoric acid.

On heating the powdered concentrates mixed with soda carbonate and potassium cyanide on charcoal before the blowpipe, a bead of metallic tin was obtained, proving the presence of cassiterite.

Mr. Rands in his report on the Albert and Logan district,† published in 1889, refers to the layers of black sand containing gold, on the beach between the mouth of Nerang Creek and Tweed Heads, but no mention is made of platinum, tinstone, or monazite. Mr. Rands was of opinion that the gold came from the siliceous rocks up the creeks. He further says that at the mouth of Currumbin Creek several layers from one to six inches thick had been worked, one at a depth of 16 feet yielding four ounces of gold in a week, but water in the sands was giving a good deal of trouble.

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* With Appendices on the Beach Sands of New South Wales, and the Physica Properties, Sources, and Uses of Platinum, with two Plates and three Figures.

† No. 51 of the G.S.Q. Publications.

In the following pages it is shown that at intervals along the Currumbin-Coolangatta Beach the sands contain payable tin, accompanied by gold. The concentrates, however, assay very much lower than was expected, and the assays show that the work thus far done for tin has been at a loss—either owing to local poverty of the ground or to escape of tinstone with the tailings. Nevertheless the hope is entertained that the ground may yet be proved sufficiently rich for dredging.

LOCALITY AND TOPOGRAPHY.

The ground likely to be auriferous lies between the mouth of Currumbin Creek and Point Danger, a total extent of five miles.

On the north-west of the area, within one and a-half miles of Currumbin Creek, are several outcrops of schists and slates forming low hills and ridges—the extremity of Macpherson's Range. At the south-east, for a little over a mile from Point Danger, there are areas of clay-slate capped in great part by dolerite. The intervening lowlands consist of sand dunes and swamps, there being not a single rock outcropping along the beach for a distance of three miles.

The southern boundary of this ground is determined by Cobaki Creek (in New South Wales), the average width of the ground being one and a-half miles; only one-half of it, however, is in the State of Queensland.

The sand, as in New South Wales, is grouped into long low ridges running parallel to the present beach and separated by flat, sometimes swampy, ground. The dunes in this locality never reach a greater elevation than 20 feet above high-water mark, this being in part due to the great hold which the stunted vegetation has secured upon the sand.

The inference is inescapable, on viewing the ground or the map, that this area was formerly an inlet of the sea into which Cobaki Creek emptied itself. The continual throwing up of sandbars by the combined action of the river and the sea, and the infilling of the lagoons thus formed, account for the reclamation. Such action can now actually be seen in progress at the present mouth of the Tweed River.

It is believed locally, however, that the sea has during the last twenty years encroached on the land at Currumbin Beach from one to three chains.

GEOLOGY.

The only place where anything of the structure of the sand deposits can be seen is in the bank (1 to 15 feet in height) on the upper edge of the beach. As this is continually being broken down the

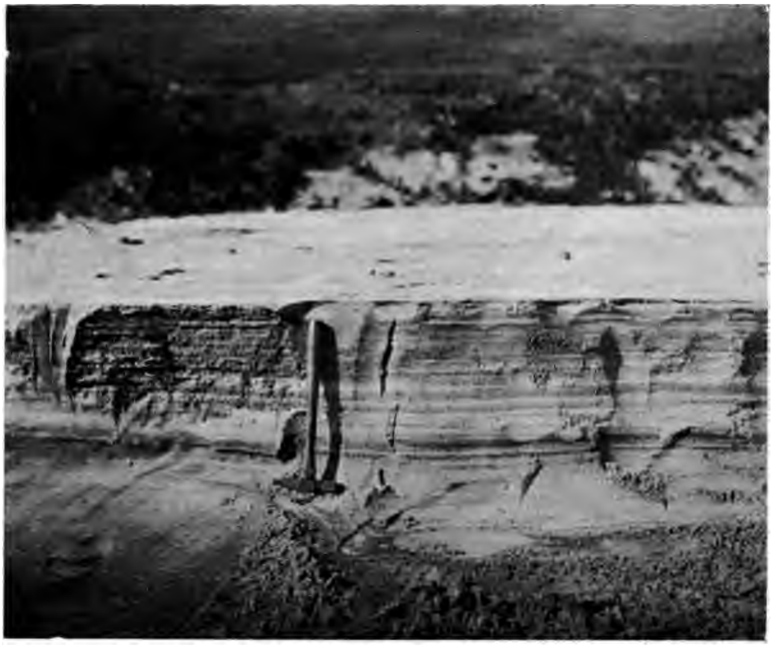

Photo. L.C.B.

PLATE 1.—BLACK SAND SEAMS EXPOSED IN BANK,
CURRUMBIN BEACH.

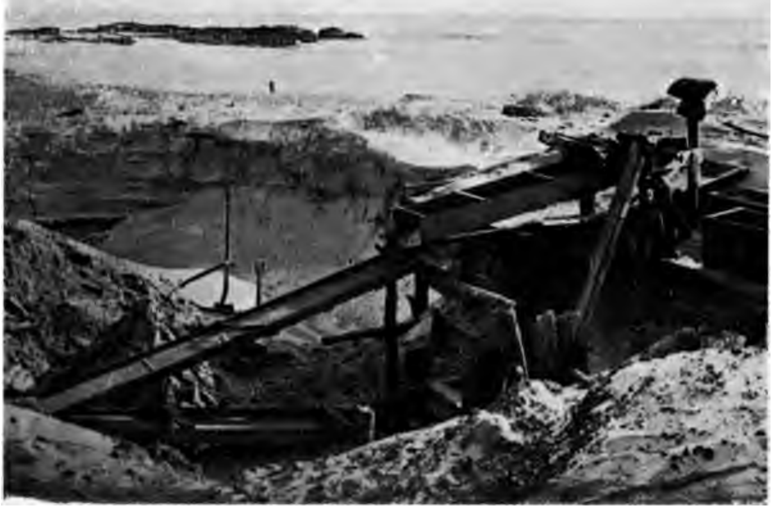

Photo. L.C.B.

PLATE 3.—WORKING WITH SLUICE BOXES, CURRUMBIN BEACH.

alternating layers of black and white sand forming it are exposed to view. The black layers vary from a fraction of an inch to 18 inches in thickness. In a very few places they are entirely absent, but often they are found from top to bottom of the bank, increasing in thickness towards the bottom. (*See* Plate 1.)

The greater part of the beach is, after storms, covered with a layer of black sand, sometimes over a foot thick, but more often only a few inches, in which latter case underneath it are generally alternating layers of white and black sand.

The concentration can be observed in progress. It is due simply to the power of the incoming waves during heavy southerly and south-easterly gales to carry all the finer material (white sand, black sand, tinstone, gold, &c.), to the upper part of the beach, while in retiring they carry off only the white sand. Thus, the black sand tends to increase in the upper part of the beach, and, for the same reason, that part has always proved richest in gold.

In prospecting the surface sands along the beach, it was noticed that the parts richest in gold were those in which brownish tinstone could more readily be distinguished, because of the concentration there being a little "closer."

It is possible that in the beach concentration of the heavier minerals also takes place, as in ordinary stream alluvium, by their sinking through the saturated sands, and causing enrichment of the lower layers, though no proof of this can be offered.

ORIGIN.

The origin of similar deposits in New South Wales, which have been studied to a far greater extent than ours, has not been definitely determined, though many suggestions have been offered.

The ilmenite and magnetite, it may be taken, have been derived from the decomposition and erosion of the basalt sheets which formerly capped this part of the coast (as proved by the numerous outliers still to be seen). That the gold has been derived from the same rock is not beyond the bounds of probability, it having been reported as occurring in diorite in Russia, South Africa, and Victoria. The platinum is even more likely to have occurred originally in the basalt, though its parent rock is believed to be ultra-basic.

It has been suggested that the gold has been derived from reefs in the basal slates. In certain parts reefs—generally almost barren—are very numerous; and again, there are large stretches, as in the locality under discussion, where there are no reefs. Reefs may, nevertheless, have contributed to the supply.

The remaining theory is that the heavy minerals have been carried down from the Stanthorpe-New England tinfields, a distance of nearly 100 miles in a straight line. Even with the fall of 3,000 feet, it is difficult to conceive that the minerals should have travelled such a distance. It is more feasible that they have been derived from rocks, either slates or basalt, in the immediate neighbourhood, in which they occur in too small quantities to have yet been detected.

METALLIC CONTENTS.

Colours of gold were found (in May last) in the black sands on the present beach in almost every spot tested, and the prospects obtained near the old shipwreck, three-quarters of a mile south-east of the Flat Rock (one mile south of Currumbin Creek) were sufficiently encouraging for the ground to be worked, but in September most of the black sand had disappeared. Though the gold may not have been present in payable quantities in the majority of cases, its presence at all certainly pointed to the lower sands being worth prospecting.

Miners now working on the beach affirm that there is, towards Coolangatta Creek, a rich 12-inch layer at a depth of from six to eight feet.

They believe that the seam continues uninterruptedly from Flat Rock, and that it dips south-east along the beach as well as seawards; so that, though above high-tide mark at Flat Rock, it is considerably below at Coolangatta. Owing to the spring tides prevailing, we were unable, in September, to reach the seam more than half a mile south-east of Flat Rock. At that point it is 18 inches thick, and a sample from it assayed (Government Analyst):—

Tin	0.18 per cent.
Gold	12 gr. per ton
Silver	4 dwt. 2 gr. per ton
Platinum	trace.

The above is equivalent to 5.12 lb. tinstone per ton, and it probably equals 1½ lb. tinstone to the yard from the surface.

A mile south-east of Flat Rock there are alternate black and white seams from the surface to four feet depth, with a six-inch seam of black sand at the bottom. A sample from the whole four feet yielded (Government Analyst):—

Tin	0.17 per cent.
Gold	1 dwt. 19 gr. per ton
Silver	3 dwt. 22 gr. per ton
Platinum	trace.

This is equivalent to 4.84 lb. tinstone per ton.

A sample washed here yielded an equivalent to 7,7 lb per ton.

Another sample was taken from a six-inch seam at five feet depth in the bank (at about the level of the highest tide), 1½ miles south-east of Flat Rock, and yielded (Government Analyst):—

Tin	trace
Gold	1 dwt. per ton
Silver	4 dwt. 10 gr. per ton
Platinum	trace.

A sample washed off in the pan yielded 12 gr. to the pound, which is equilavent to 3.8 lb. per ton.

Prospects from a seam in the bank three-quarters of a mile north-west of Coolangatta Creek showed from ⅓ lb. to 1 lb. tinstone per ton.

A sample from a six-inch layer at the surface of the beach at the shipwreck, five-eighths of a mile north-west of Coolangatta Creek, yielded (Government Analyst):—

Tin	0.64 per cent.
Gold	17 gr. per ton
Silver	4 dwt. 20 gr. per ton
Platinum	trace.

This is equivalent to 18.21 lb. tinstone per ton.

The white sand on the beach hereabouts contained from ⅒ lb. to 4 lb. to the ton, as well as colours of gold.

In order to try and reach the deeper seams, a hole was sunk two chains back in the "terrace," 200 yards north-west of the mouth of Currumbin Creek, but water was struck at a depth of ten feet and prevented further sinking. At eight feet depth is a four feet layer of brown sand, stained by peaty water, and this yielded 3 gr. of tinstone to the pound, equivalent to almost 1 lb. to the ton.

A 15-feet bank, 15 chains north of Coolangatta Creek, yielded traces of tinstone and specks of gold.

The seven-feet bank of brown sand east of Coolangatta Creek prospected ⅓ lb. tinstone per ton, but probably contains many times as much. At this spot there are several thin seams totalling 18 inches, two feet under the beach, prospecting ⅒ lb. per ton.

At the mouth of Flat Rock Creek, a few chains north of Flat Rock itself, and at the bottom of the bank is a four feet band of black seams, which prospected ¾ lb. per ton, and assayed (Government Analyst):—

Tin	0.26 per cent.
Gold	1 dwt. 7 gr. per ton.
Silver	7 dwt. 2 gr. per ton.
Platinum	trace.

This yield is equivalent to 7.39 lb. tinstone per ton.

(For other assays see under "Workings.")

WORKINGS.

Two claims were, at the time of my first visit, held at the north-western extremity of the beach, near Flat Rock.

In one, just pegged out, a hole had been sunk to the "wash" but had been filled up again through the sea breaking-in.

The other claim, about two and a-half chains south of Flat Rock, had been worked for some months, and had lately changed hands; so that the owners, having put through only four loads, could give me little information as to the contents of the ground.

A 12-inch seam of black sand and a two-inch seam a few inches below it yielded the gold, and to get at them it was necessary to remove six feet of overburden (black and white sand in alternating layers). The seams dipped seaward at a slightly greater angle than the present beach.

A few pounds of the sand were taken from the face of the seam exposed—only a few feet in width—and the Government Analyst found traces of gold and silver, but no platinum. It is, however, recognised that the platinum does not occur distributed througout the whole of the sand, being often conspicuously absent during many days' work.

A small sample of the tinstone, monazite, and platinum concentrates was seen, in which the platinum amounted to many ounces to the ton.

At the time of my second visit (in September) the miners, still working in the same locality, about two and a-half chains south of Flat Rock, had combined, and pegged out the whole of the beach between Coolangatta and Currumbin Creeks as a dredging area. The width of the area north of Flat Rock is only about three chains, while southward it extends back five to ten chains, to the railway line.

A hole had then been sunk in the "terrace," two chains back from the beach, to the west of the workings. At five feet depth it passed through a four-inch seam of black sand (reported to carry 12 gr. of gold and platinum), 15 inches grey sand (with tinstone), and 17 inches black and white sand. A sample from the whole three feet, including black and white sand, assayed (Government Analyst):—

Tin	trace
Gold...	5 gr. per ton
Silver	3 dwt. 22 gr. per ton
Platinum	trace.

These seams, though on about the same level, have been proved by the miners to be distinct from those worked on the bank just above the beach.

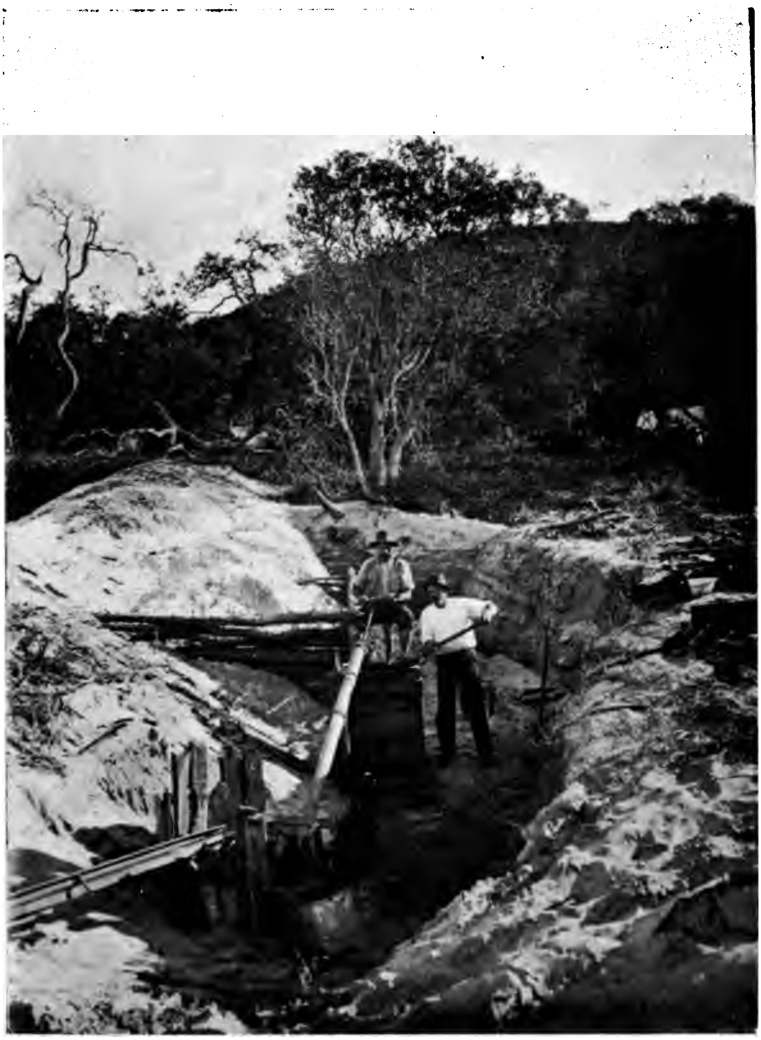

Photo. L.C.B.

PLATE 2.—WORKING WITH COPPER PLATE- AND BLANKET- BOX,
CURRUMBIN BEACH.

In the present workings, near the edge of the bank, their main seam (12 inches to 15 inches thick) is six feet deep. A sample from the seam where exposed yielded (Government Analyst):—

Tin	0.12 per cent.
Gold	trace
Silver	3 dwt. 12 gr. per ton
Platinum	trace.

This is equivalent to 3.42 lb. tinstone per ton.

Just beneath it is a thin seam two inches to six inches thick, generally very rich in gold, while about a foot above it is a four-inch, practically barren, seam.

About three chains south-east of the paddock there is a four feet seam of black platiniferous sand at five feet depth, a sample from the upper part of which contained (Government Analyst):—

Tin	trace
Gold	5 gr. per ton
Silver	4 dwt. 22 gr. per ton
Platinum	trace

TREATMENT.

In prospecting, very great difficulty is experienced in saving the gold, platinum, and tinstone, owing to their extreme fineness and the high specific gravity and comparative coarseness of the associated minerals. For this reason it is practically useless to attempt to estimate the contents by vanning, especially of samples weighing more than two pounds. Accurate results can, therefore, be obtained only by chemical analysis.

The treatment employed till quite lately consisted in passing the auriferous sand over copper and blanket tables, the arrangements shown below being employed. The black sand was thrown into the perforated hopper, and sea water, pumped on to it, carried it through to the spreading tray and over a mercury feed-riffle on to the copper plate, and thence on to the blanket table. The tailings then passed into the sump box, out of which they were shovelled on to the dump. (See Plate 2 and Fig. 1.)

Most of the gold was caught on the copper plates, while platinum, tinstone, and monazite remained on the blanket table, where it was found that Brussels carpet proved much more efficacious than blanket in saving the heavy minerals.

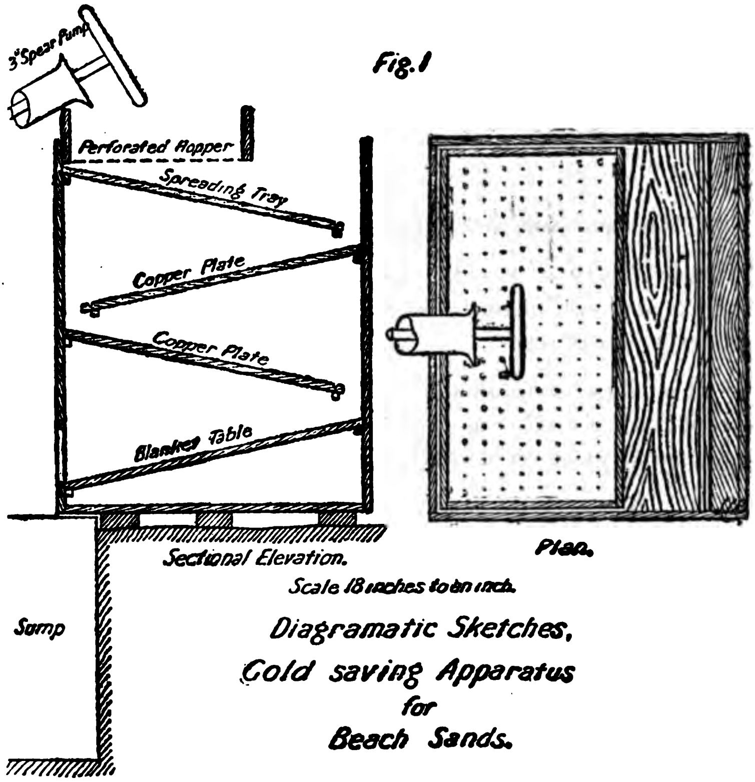

FIG. 1.—DIAGRAMMATIC SKETCHES, GOLD-SAVING APPARATUS FOR BEACH SANDS.

The above method failing to give satisfaction in new hands (partly owing to the difficulty experienced in keeping the copper plates bright), an entirely new arrangement has now been devised. (See Plate 3.) This consists essentially of 30 feet of blanket tables 15 inches wide, with an inclination of 1 in 5, this having been proved experimentally to give the best results.

Water is raised from the well-hole (to which it has first been carried in buckets from the sea) by a spear pump discharging on to the perforated box, into which the sands are thrown. The lighter sands are washed down over the blankets to the sump, from which the tailings have to be shovelled on to the dump, while the water is returned to the well.

Three men are required to work the plant—one feeding sand, one pumping, and one removing tailings from the sump.

The plant has been in operation two weeks, during the first of which 191 lb. of concentrates were obtained, assaying (Government Analyst):—

Tin	8.3 per cent.
Gold	1 oz. 16 dwt. 8 gr. per ton
Silver	12 dwt. 19 gr. per ton
Platinum	trace.

This is equivalent to 10.54 per cent. tinstone—*i.e.*, 20 lb. tinstone, worth, at 7d. per lb., 11s. 8d.

During the second week a total of half a ton of concentrates was separated from 20 tons of black sand. Those from the upper blankets, amounting to three cwt. contained (Government Analyst):—

Tin	1.69 per cent.
Gold	7 dwt. 5 gr. per ton
Silver	5 dwt. 5 gr. per ton
Platinum	trace.

This is equivalent to 2.15 per cent. tinstone—*i.e.*, 7¼ lb. tinstone obtained, worth 4s. 2¾d.

Those from the lower blankets (seven cwt.) contained (Government Analyst):—

Tin	0.10 per cent.
Gold	22 gr. per ton
Silver	5 dwt. 3 gr. per ton
Platinum	trace.

This is equivalent to 0.13 per cent. tinstone—*i.e.*, 1 lb. tinstone, worth 7d.

These returns show plainly that the results have hitherto not justified the work done. The assays given in previous pages show that the sands contain, at least in parts, payable quantities of tin. The 20 tons of black sand put through in the second week should have yielded 70 lb. of tinstone, which would have been worth £2.

The miners' estimate that they have averaged a ton of black sand for each 10 square feet of the claim so far worked, and this agrees with the calculated yield. It has been shown that 20 tons of black sand yielded ½ ton of concentrates containing 8¼ lb. of tinstone, to obtain which it is necessary to shift 60 tons of overburden, the yield per ton of material moved being thus 0.14 lb. of tinstone. (It was expected by the miners that the tinstone would amount to 2 cwt.)

It was proposed to instal a 2-inch pump, throwing 1,000 gallons an hour, worked by a 2 horse-power oil engine, consuming one pint of oil per horse-power per hour (or one case of kerosene, at 5s. 6d., per week).

A further contemplated improvement is a scoop worked by a horse, by means of which the bank may be worked down in a face from the sea.

The result of these improvements should be a greatly reduced handling of the material (the tailings being run out on to the beach), an increased turnover, closer concentration, and consequently a greater profit, enabling more thorough prospecting to be carried out with a view to the ultimate dredging of the ground.

For the treatment of the sands between tides the surf washer described in the "Mining and Scientific Press" of San Francisco, and the "Queensland Government Mining Journal"* from which the accompanying illustration has been taken, should give good results.

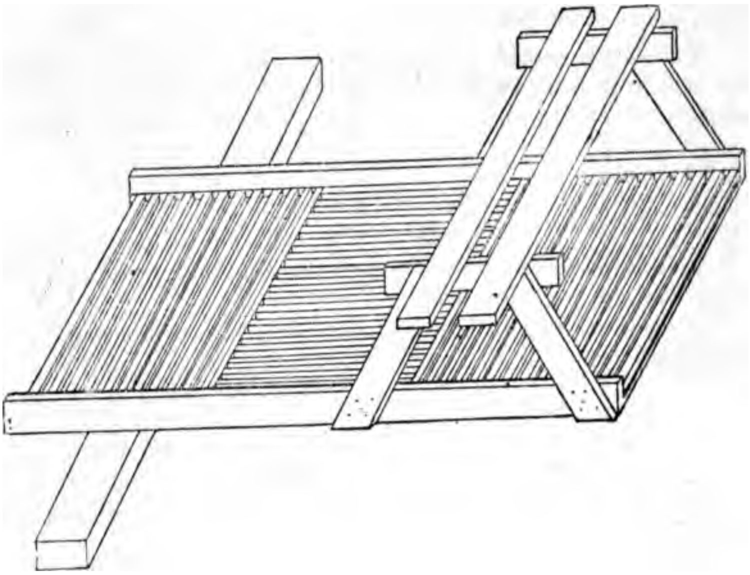

FIG. 2.—SURF WASHER FOR BEACH SANDS.

The sluice box is 8 to 12 feet long and 3 or 4 feet wide, with sides raised 2 or 3 inches above the riffles, which are divided into sections for cleaning up. Amalgamated copper plates may also be used, and quicksilver should in any case be placed in the riffles. The box (inclined 1 in 14 to 1 in 18) is weighted down, within reach of the waves, by sand bags on the crosspiece at one end and the raised platform at the other. The riffles shown are square in cross-section, but they would probably give better results if cut back beneath on both sides, so that their cross-section would be trapezoidal.

PROSPECTS FOR SLUICING OR DREDGING.

It is recognised that it does not pay to work the seams as at present with sluice boxes, but it is held that, with a pump and engine on the ground, the most laborious part of the work (carrying water from the surf and raising it to the tables) will be obviated, and there seems to be every probability of the work being profitable, especially if, as proposed, a horse and scoop be employed also.

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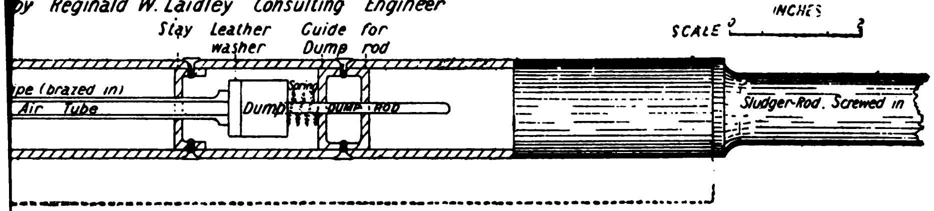
* Vol. IV., 1903, p. 643.

by Reginald W. Laidley Consulting Engineer



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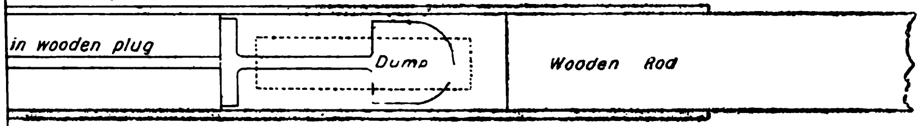

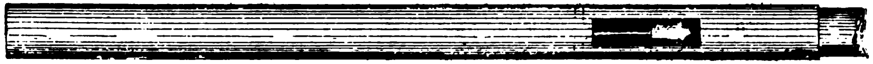

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altitudes in Mount Stewart's Head, on the eastern edge of the field, near Herberton, this mountain, according to S. B. J. Skertchly being 4,400 feet* above the sea.

North-east of Herberton the range bifurcates. One spur goes northerly as a continuation of the main divide, parting the head-waters of the Walsh from those of the Barron. Its altitude gradually lessens till, at a point about 18 miles north of Herberton, where it is crossed by the Cairns to Chillagoe Railway line, it is no longer recognisable as a range, but forms an almost level plain at a height of about 1,700 feet, with the waters of the Barron flowing to one side and those of the Walsh to the other.

The second spur runs south-easterly in an opposite direction, hemming in the head-waters of the Herbert River. The two spurs form a rampart parallel with the coast, and at a distance of some 30 miles from it, presenting an abrupt face towards it for some 60 miles in length, and cutting off the tinfield from easy communication with it. At the foot and up the sides of this range extends a belt of basalt country, thickly covered with scrub. which has greatly added to the difficulties of surmounting the range. Till within recent years the whole of the traffic passed through the northern end of this scrub from the terminus of the railway line at Mareeba, by Atherton, and over the range by a steep ascent to the head-waters of the Wild River at Herberton. Of recent years the construction of the Chillagoe Railway line and its branches has drawn off a considerable amount of the traffic in a northerly direction.

The tin mines lie scattered in groups down both sides of the main divide, the greater number being within a radius of some 50 miles from a central point. The rugged nature of the greater portion of this district, and the consequent high cost of haulage of ores and machinery, has added greatly to the expenses of development of the mines. With the extension of railway and tramway communication, the latter of these two factors has been considerably reduced, but the haulage of ores from the numerous mines scattered about the hillsides to places convenient for treatment, is still a very heavy item in mining costs, and one to which the greatest attention must be paid in any scheme of profitable development.

II.—GEOLOGY OF THE ORE DEPOSITS.

The oldest rock formation of the Heberton Tin Field is a series of alternating coarse and fine sedimentary beds. They have been folded and faulted by pressures acting from east and west, and are now generally found lying at high angles of inclination, their irregular and broken lines of strike running in northerly to north-westerly directions. These rocks have been altered by long ages of pressure and chemical change, till their coarser beds have been metamorphosed into quartzites and greywackes, and their finer beds into slates and schists. Subsequent denudation has removed them over the greater portion of the tin-bearing area, and has thus exposed the underlying granite rocks over the greater part of the district.

The sedimentary rocks cover a large area in the centre of the district south from Irvinebank, and occur also in smaller areas near Watsonville, Stannary Hills, Koorboora, and California Creek. Their boundaries are only roughly defined on the map, the time at the disposal of the writer, the scanty nature of the topography, and unsurveyed character of the greater portion of the district not having allowed of their being accurately mapped. A great number, perhaps the greater number of the more important lodes, are associated with these rocks, occurring generally in the coarser greywackes and quartzites.

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* Tin Mines of Watsonville. S.B.J.S. G. S. Q. Publication No. 119. *See* Map.

The plutonic rocks consist mainly of holo-crystalline types of biotite or hornblende granite. There are, however, large areas of euritic types, such as granite porphyry, and quartz felsite. Lodes of tin occur in both. Dykes of elvan intrude both the plutonic and altered sedimentary rocks.

The tin lodes are for the most part very irregular in their manner of occurrence. The deposits of ore seldom lie along a well-defined course between walls of country rock, but are, as a rule, distributed through it in an irregular manner, forming bodies of very varied size and shape. The lode material is only in exceptional cases separated by well-marked planes of division from the enclosing country. As a rule it merges into it with a gradual change from lode material to barren rock. The lode material is in almost all cases evidently a product of the alteration of the country rock by the action of mineralising agents, which have changed its constitution by chemical action, and have at the same time deposited tin and other minerals within its interstices.

In the case of the granitic rocks the alteration to lode material takes many forms, giving a variety of ores of widely differing appearances. The alteration varies, however, more in degree than in general character, and can, as a rule, be readily understood. The felspar and other silicates may be changed to serpentine or chlorite, or may be completely replaced by silica. In other cases the products of alteration are sericite and silica. In some cases very little alteration is noticeable to the eye, the tin occurring in grains through the apparently unaltered granite or porphyry. The results are ores varying through every degree of alteration, from the normal granite rock, splashed through with grains of tin, to purely silicious tin-bearing material.

In the sedimetary rocks the lode material varies from an almost unaltered quartzite, showing under the microscope crystals of tin in the interstices between its grains, to a massive green chlorite, which weathers on the surface to a rusty-red kaolinic material. A normal sample of "chlorite ore" from the 500-feet level in the Vulcan Mine, showed under the microscope a mass of grains of quartz and felted patches of chlorite, splashed through with crystalline grains of tin and magnetite. In the alteration of these greywacke and quartzite rocks also, the silicate minerals have evidently been first attacked, and changed into chlorite by the mineralising solutions.

The fluoric minerals—topaz, fluorspar, and tourmaline—generally found associated with tin deposits, are of very usual occurrence, both in the lodes in the granite, and those in the sedimentary rocks, while the metallic minerals—wolfram, bismuthine, antimonite, galena, chalcoprite, and magnetite—are frequent accompaniments, often in sufficient quantities to be a source of considerable trouble in the treatment of the ore.

Mr. Jack, in his report on the mines near Herberton and Watsonville,* thus discusses the manner of formation of the ore bodies:—

> One fact unnoticed and unsuspected when I wrote my first report comes out clearly and unmistakably from a detailed examination of the field, now that something more than the mere surface is accessible to observation. That fact is the intimate connection of the tin deposits with metamorphosed igneous dykes. Such dykes, emanating from a deep-seated reservoir of molten matter, forced their way under pressure into fissures in the solid porphyry rock and consolidated as basic igneous rocks. The basic rocks of the dykes seem to have undergone a gradual process of metamorphism. The dykes now consist mainly of quartzose chlorite and occasionally of quartzose serpentine. It may be inferred that they were originally consolidated as quartz diorites or as rocks more or less of the basaltic type. The tin occurs in floors, veins, or pipes among the joint-planes of the dykes.

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* *Opus cit.*, page 30.

It is quite possible that the tin may have come up in the first instance molten with the molten mineral matter of the dyke. In that case it is probable that it was afterwards dissolved and redeposited in the open joint-planes of the dyke. A further separation and redistribution may have taken place simultaneously with the chemical or electric action which resulted in the metamorphism of the dykes.

On the other hand, the tin may have first come up in solution, after the consolidation of the dykes, along the walls of the latter and among the fissures and joint-planes by which they were traversed, and been deposited there. A re-solution of the tin ore would probably take place on the metamorphism of the dykes; and as the metamorphosed dykes had probably a new joint-system developed in them, a further concentration of the ore may have taken place.

In any case there is nothing to favour the supposition that waters containing tin in solution and circulating through the upper portion of the earth's crust failed to deposit tin ore in the porphyry, but deposited it immediately on meeting with the metamorphosed dykes. On the other hand, there are good grounds for supposing that the tin was carried up, either with the dykes in a molten condition or was carried up in solution by mineral waters along the lines of the dykes. In either case the permeation of the adjacent porphyry by the mineral waters may explain the occasional occurrence of tin ore in the "country rock." In either case, as the dykes have originated in a deep-seated mass of molten matter, they may be expected to carry the tin ore to greater depths than are ever likely to be reached by mining. The metamorphosed dykes are traversed by a series of dykes of quartz porphyry, strictly analogous to the elvans of Cornwall. They do not, however, appear to be in this field prolific sources of ore. Indeed, the Three Star and Herberton Ironclad elvans are almost the only known cases of stanniferous elvan. It appears, however, from the cases of the Erin-go-Bragh and Southern Cross that the elvans have occasionally served to reopen the basic dykes and permit of a further local deposition of tin ore.

In the light of more extended developments of the lodes of this district, and of the now almost universally accepted theory—first enunciated by Daubree and subsequently developed by other French investigators—as to the method of introduction of tin into lodes, I do not think that Mr. Jack's theory of their intimate connection with altered basic dykes can be accepted as an explanation of the cause of their formation. An examination of the geological conditions obtaining in the Great Northern, Vulcan, Great Southern, Alhambra, Smith's Creek, Ivanhoe, Extended, and many other lodes, shows no such connection. The chloritic and serpentinous gangue materials of each of these lodes can, I am of opinion, only be explained as the result of the alteration *in situ* of the country in which they occur, by the action of mineralising vapours and solutions. Genetically there seems little doubt that the lodes owe their presence to the intrusion and solidification of the granite mass in and around which they occur, their metallic contents having been extracted from the molten granitic magma in the form of gaseous sulphides, fluorides, and borides, as the mass solidified downwards and became creviced and cracked on its outer surface. The fracturing of the overlying sedimentary rocks, near their contact with the heated granite, would allow of the permeation into them also of these metal-bearing vapours. The subsequent precipitation of their metallic contents, with an accompanying change of the wall rocks of the fissures, would be brought about on their meeting with the cooler streams of the meteoric waters descending from the upper portions of the earth's crust.

If this theory of the mode of formation can be accepted for the tin deposits of this district, the cooling rocks on either side of the outer edge of the granite mass at the time of its intrusion would thus be the chief seat of tin deposition. The prevalence of the tin lodes on both sides of the contacts of granite with the overlying sedimentary rocks, as is seen by a glance at the accompanying map, lends colour to the applicability of this theory as to their origin in the district under review. The dissemination of the tin in crystalline grains through these altered zones of rock, and often through rock which shows little sign of alteration, can more readily be understood on the hypothesis that it was introduced in a form so capable of permeating rock masses on either side of open fissures than on any other.

The applicability or otherwise of this theory may have an important practical bearing. Many of the larger lodes are being worked in the sedimentary rocks close to their contact with the granite. If the source of the tin is the everywhere underlying granite, it may possibly be that as that rock is approached the deposits of ore will become richer and larger. On the other hand, since the first introduction of the tin, there has probably been considerable reconcentration of the metallic contents by the circulation of the ground water, as the surface level has been lowered by denudation. This may have so overbalanced the tendency to enrichment as the granite is approached, that quite the contrary may be the case. The evidence collected by the writer was not sufficiently detailed to allow of any opinion being formed on this important question.

In a few cases the ore deposits are associated with dykes of elvan, and, possibly, of diorite, the parting between the dyke rock and the country having formed a line of weakness by means of which the mineralising agents were enabled to gain access from below, and alter the rock on either side to lode formation. The Gully lode at Herberton was apparently an example of lode material formed alongside of an elvan dyke, and, according to Skertchly, many of the lodes at Watsonville were found associated with dykes of diorite. In his report on this district Skertchly says:* "There are no lodes in the whole district but are associated with either elvans or basic dykes." This statement is, however, much too general to be accepted for the whole of the district, for in the case of many of the most important lodes there is no sign of any connection with intrusions of igneous rock.

In the greater number of cases the fracturing of the rocks by the pressures to which they have been subjected by earth movement, has apparently been quite sufficient to allow of their permeation by the mineral-bearing vapours from below. The irregular character of the tin deposits seems to be due primarily to the irregular disposition of these fissures and fractures through the country. The alteration of the rock and deposition of mineral in the neighbourhood of these fractures followed no regular plan, but apparently occurred wherever local conditions were favourable to their permeation by the mineralising vapours and solutions. The prevalence of the occurrence of large ore bodies in the harder greywackes and sandstones of the sedimentary series and their scarcity in the softer and finer-grained schists is interesting in this connection, as it can easily be imagined that, owing to their greater hardness and less flexibility, the former rocks would be more likely to form open fissures under the influences of strains, while the coarseness of their grain would probably afford freer access to the permeation of solutions through their mass.

In many cases this irregular disposition of the fractures which have determined the admission of the lode material, has given rise to large bunches of rich ore showing little trace of any connection with other deposits. This seems to have been especially the case in the ore bodies found in the granite, though it obtained very frequently also in those occurring in the sedimentary rocks. Large and rich bodies of ore have to all appearance completely cut out within a few feet of the surface, leaving no clue that could be traced down to any similar and connected occurrence of ore below. The theory of the introduction of the mineralising agent in gaseous form, which would presumably allow of their passing through fissures of the rock for long distances, where the conditions were not favourable to permeation on either side, no doubt explains such occurrences. In many cases lodes, after apparently "petering out" completely, have been picked up again by following down narrow strings of mineral, or by haphazard prospecting at greater depths, and have opened out into bodies of as great or even greater extent than those that led to their being prospected. Thus the Vulcan lode at Irvinebank has been worked to a depth of 700 feet, though the lode was on two occasions completely lost as work proceeded downwards.

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* *Op. cit.*, page 45.

III.—CHARACTER OF THE MINING.

The irregular manner of occurrence of the ore in these lodes has had a marked influence on the character of the mining in this district. In the case of mineral matter introduced along true fissures, extending with comparative regularity over considerable distances both horizontally and vertically, and carrying lode material between well-defined walls, or impregnating the country rock more or less evenly on either side, a certain amount of confidence can be displayed in prospecting and development work. If the lode becomes too narrow or too poor for profitable working, development work is pushed on either horizontally or in depth along the line of fissure. with a fair prospect of the lode again widening or improving in value along the same line. Where, however, no such irregularity of disposition of the ore exists, as in the case of most of the Herberton lodes, only the general run of the ore body can be followed as a guide for fresh prospecting work.

One of the most noticeable features of the ore bodies is the shortness of the shoots in horizontal extent. In the Launcelot Mine at Newellton, at the 150-feet level, the lode has been stoped for 200 feet continuously on ore. The next longest working on a continuous body is at the 500-feet in the Vulcan Mine, where the stope has been carried along for about 150 feet on ore. At the 100-feet level in the Smith's Creek Mine the ore was taken out for about 78 feet in length. These, however, are three of the longest continuous shoots that have been worked on the field, the majority rarely reaching 50 feet in length. Nor do they often lead on to others in the same line, connected genetically with them, and capable of being worked from the same shaft.

Their want of length is often compensated for, to some extent, by considerable thickness, and bodies of ore, of nearly the same dimensions in either direction, are of frequent occurrence.

The greatest hindrance to continuous and economic mining of these lodes is, however, the want of continuity of the shoots of ore as they are followed downwards. Repeated instances of unsuccessful attempts to pick up large and profitable shoots of ore by driving 50 feet or 100 feet below where they are being stoped, have convinced the tin-miner in this district that his hopes of picking up a lost lode again in the position in which it might naturally be expected, are more often disappointed than not. Frequently a long period of prospecting in different directions has to be gone through before fresh ore reserves can be developed, with often little or no indication except the general dip of the shoot above to serve as a guide.

The want of continuity of the deposits makes the economic location and proving of fresh ore reserves, in advance of those already developed and in course of extraction, a matter of the greatest importance. Where the lodes follow no true course, as such is understood with true fissure lodes, and where the break in continuity is not due to a faulting of the country subsequent to the formation of the ore body, it is useless to attempt to apply rules of procedure for finding lost lodes that have been framed to suit well-defined deposits with definite course and dip. The only course open seems to be that universally adopted by the experienced tin-miner—namely, to follow the tin as far as it will lead, in the hopes of its making into another body of ore, and when this can no longer be done, to use the individual judgment in prospecting in the most likely place in the most economic manner that can be employed. In this connection it seems likely that, in the case of large bodies of ore like those found in the Vulcan, Smith's Creek, and many other mines where the tin is disseminated with comparative evenness through an extensive mass of lode material, the diamond drill might be employed with advantage by saving much profitless driving and sinking, and allowing of the opening up of fresh ground in the most convenient manner. In any case, the importance of keeping development work well ahead of present mill requirements cannot be too strongly insisted on with lodes of this character, if the undertaking is to prove profitable to the shareholders.

The small size of the great majority of the lodes, combined with their richness, has made them peculiarly adapted to return good profits to small parties of working miners. Their bunchiness and want of regular continuity when followed downward frequently gave rise to correspondingly irregular methods of working, often entailing two or three handlings of the ore before it could be brought to the surface. In this way depths were soon reached at which it became impossible to handle anything but the richest ores at a profit, and the majority of the lodes were gradually abandoned before any great depths had been reached. Many of the larger ore bodies, especially amongst those occurring in the sedimentary rocks, were early found to be too poor for profitable mining with the low price ruling for tin before 1898. They were abandoned at shallow depths. Increased prices, however, inspired the hope that many of these could be made to yield profits if provided with batteries close at hand, and with the application of more up-to-date methods of mining.

It is lodes of this character, some of them scarcely prospected before, that have attracted attention of late years at Coolgarra, Stannary Hills, Koorboora, and other places. They have accounted for a large proportion of the increased yield during the last three years, and must be looked to to maintain the output in the future.

The varied character of these lodes demands considerable originality of treatment in each case, both as to the method to be employed in mining them and in the subsequent treatment of the ore. The uniform methods generally found prevailing on all mines of one particular field must be diversified here to suit the peculiarities of each lode. There is, in fact, scope on this field for the employment of the best mining skill available, if waste of funds in unprofitable surface works and unsuitable mining methods is to be avoided, and the lower grade propositions are to be made remunerative.

IV.—HISTORICAL AND STATISTICAL.

Alluvial tin was first worked behind the coast range in the early part of 1880, on Prospector's Gully, near the present town of Herberton. The first lode—the "Gully" lode of the Great Northern Freehold—was found a little higher up the same gully a few months afterwards. Stream tin had been worked previously to this on Tinaroo Creek, east of the coast range, but apparently it was not till the opening of the ports of Cairns and Port Douglas in 1879 that much attention was paid to the mineral deposits west of the range. Mr. Jack, who visited the Herberton lodes in 1880, thus describes the history of their discovery:—*

> This neighbourhood was described by Mulligan as stanniferous as much as six years ago (1874), but as there was then no nearer port than Cooktown, the expense of land carriage would, of course, have rendered the working of tin unremunerative. The harbours of Cairns and Port Douglas having, however, at length been opened, and the basaltic regions in the valleys of the

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* Report on the Wild River Tin Mines, 1880. R.L.J., Geological Survey Publication No. 10.

Herbert and Barron having been taken up in squatting runs, attention was again directed to the tin deposits. Mr. Atherton, of Emerald End, on the Barron, having found stream and surface tin in sufficient quantities to warrant further prospecting, took up John Newell and several others from Tinaroo (about 30 miles off) to the heads of the Wild River in the latter end of 1879. This party found stream tin in payable quantities in Prospector's Gully, on the left bank of the Wild River, near the present township of Herberton. Four months later William Jack and party explored the neighbourhood of Prospector's Gully, and were rewarded by the discovery of the Great Northern lode. Other lodes were quickly found and taken up by the miners, who shortly afterwards rushed the ground.

The discovery of the lodes near Herberton, and of the Great Western and other lodes in the neighbourhood of Watsonville, some 5 miles further west, led to the taking up of a great many claims in these localities. Mr. Jack, in his first report, describes as many as 109 in these two districts. During the next year a considerable amount of ore was raised and stacked, awaiting the erection of crushing machinery. Crushing began in 1883, and for the first year 12,405 tons of stone were treated for a return of 2,646 tons of black tin. In 1885 the battery at Irvinebank commenced crushing, chiefly on ore from the Great Southern Mine, and this place gradually became a most important centre. Up till 1890 the mining industry in these three localities was in a flourishing condition, and returned 15,000 tons of black tin, valued at £650,000. Batteries were also erected at Return Creek in 1885, Eureka Creek and Glen Linedale in 1888, and California Creek in 1890, but by the end of the latter year they had all ceased to work. From that time on the low prices of tin, together with the exhaustion of the surface deposits, and the more readily accessible bodies of ore, led to the closing down of many of the mines, and a considerable falling off in the output of tin. The success attending the opening up of the Vulcan Mine, however, in 1891, and the regular output from the large bodies of ore developed, kept life in the district, and afforded the sinews of war for continuous prospecting. From 1891 to 1902 the Vulcan Mine furnished more than half the total return of lode tin from the whole field, with an average yearly output of nearly 450 tons.

The sudden increase in the value of tin in 1898 led to a marked revival of interest in the field, and was followed by the formation of a number of companies. The aim of these companies was to secure groups of abandoned or languishing mines, with the intention of developing and working them in a more systematic manner than had been attempted previously.

Of these companies the Coolgarra Company at Return Creek, the Stannary Hills Company at Eureka Creek, the Launcelot Company at Newellton, the Great Northern Company at Herberton, and the Cuprite Company at Irvinebank, have been the most active, while the mines at Koorboora have been vigorously prospected by the Irvinebank Mining Company.

At this latter place a 10-head battery was erected near the Shakespeare Mine in 1899. It has been working with fair regularity since, and has crushed some 11,500 tons of ore for a return of 341½ tons of black tin, valued at £19,416.

The Coolgarra Company having erected a new 10-head battery on Return Creek, commenced crushing in March, 1901, and continued with little interruption till September of 1903. There had been no crushings at this place since 1888. The total for the last period was 21,879 tons of stone for a return of 473 tons of black tin, valued at £22,646. The greater portion of this stone has come from the Alhambra Mine. The low grade of this ore compelled the closing down of the mine in September last.

The Stannary Hills Company secured the most important mines on Eureka Creek, which had been abandoned since 1893. A tramline connecting these mines with the Chillagoe Railway line, 14 miles off, and with a 20-head battery on the Walsh River, 5 miles further east, has since been completed. The survey of the line was commenced in 1898, and the construction completed in 1902. The battery commenced crushing in August of last year, and up to the end of the year had put through 5,660 tons of stone for a return of 209 tons 17 cwt. of black tin, valued at £15,848.

The Launcelot Mine, near Newellton, on the Dry River, 7 miles south-west of Herberton, was discovered about 1895 by Harrod, and some good crushings were obtained from it at the Bischoff Mill. In 1899 the mine was bought by Mr. C. C. Clotten, of Frankfort, and the property floated into a company called the Launcelot Tin Mines. A large dam was constructed on the Dry River, and dressing machinery for a 5-head battery imported from Germany. The erection of this machinery was completed by the end of 1901, and crushing commenced in May, 1902. Three shafts have been sunk to a depth of 150 feet, and up to the end of 1903 4,190 tons of ore have been crushed for a return of 494 tons of black tin, valued at £28,234. The company have since commenced to further sink their shaft, and are proceeding with the erection of an additional 10-head of stamps.

The Great Northern Company commenced to sink the shaft on the "Eastern" lode of the Great Northern Freehold, near Herberton, which had been full of water since 1891, in June 1901. It was sunk from the 400-feet to the 700-feet level, and, during the present year, the lode was again intersected at that depth by a short drive from the bottom of the shaft. A battery is now in course of erection to treat the ore thus developed.

The Cuprite Company, at Watsonville, secured a block of ground on the hills to the south of the township of Watsonville, embracing a number of the best-producing mines in this neighbourhood. Since 1899 they have done a considerable amount of prospecting, but so far without much success.

In addition to these new batteries on old mines, there is to be noted the finding of the Smith's Creek Mine during the latter end of 1901, and the erection of a battery consisting of three Huntingdon mills and modern dressing machinery. This mine commenced crushing in January, 1903, and since then has turned out 585 tons of tin, valued at £41,093, from 18,674 tons of stone. Unfortunately, the lode has been lost below the 100-feet level, and at present there is no further ore in sight, but with further prospecting it may be expected that additional reserves will be found, and the life of the mine continued.

The addition to the field of the new crushing power detailed above has led to a marked increase in the output of tin for the last three years. For the three years preceding 1901 the average yield was a little over 600 tons of black tin per annum. Since then it has rapidly increased, till for last year it totalled some 2,268 tons, or nearly three and a-half times the former yield.

The increase in the amount of stone crushed is even more noticeable, the average percentage of the ore having been reduced by over two-fifths. This is clearly shown by the table giving the yield of the field from the commencement of crushing (Table I.). The reduction is accounted for by the fact that the increased value of the metal, combined with the erection of up-to-date mills in close proximity to large bodies of ore, has allowed of the profitable treatment of large quantities of stone which would have been too poor to pay under the old conditions of low values and long haulage to the mills.

Notwithstanding this large increase in the output of lode tin, none of the new ventures have as yet been able to become dividend-paying. The expenses of the large amount of surface work in the erection of mills, winding machinery, and tramways, have been very heavy, and in many cases the returns have not been up to expectations. The want of continuity of the ore bodies, and the difficulties of estimating reserves, has been the source of great trouble in preventing the mills from being regularly supplied, and has greatly added to the cost of mining. The Coolgarra Company closed down in September of last year, and the Smith's Creek Mine had crushed all their available ore by the end of the year. The Stannary Hills crushings have not turned out up to the expectations created by the estimates of value and quantity reported from time to time from the mine. Only at the Launcelot Mine, and at Koorboora, have the crushings been both regular and of good value, and in the case of the former the greater portion of the profits has been absorbed in providing capital for further development.

The following table gives the amount of stone crushed and tin obtained in the Herberton District from the year 1883 to the year 1903, both inclusive:—

TABLE I.

AMOUNTS OF STONE CRUSHED AND BLACK TIN OBTAINED, HERBERTON DISTRICT, FROM 1883 TO 1903.

Year.	Stone Crushed.	Yield of Tin Ore.	Percentage.	Value.	Value per Ton of Black Tin.
	Tons.	Tons.		£	£
1883	12,405	2,646	21·3	No records	No records
1884	11,031	1,902	17·25	,,	,,
1885	12,834	2,096	16·32	,,	,,
1886	14,816	2,198	14·8	,,	,,
1887	12,142	1,508	12·42	,,	,,
1888	11,159	1,390	11·70	76,400	50
1889	14,476	1,560	11·02	90,000	49 10s.
1890	13,700	1,699	12·3	104,050	49 18s.
1891	6,718	1,063	15·8	68,850	50
1892	9,481	1,181	12·46	69.450	50
1893	9,749	1,215	12·46	72,000	45
1894	7,211	1,250	17·33	67,300	35
1895	6,779	1,036	15·28	43,300	30
1896	6,630	747	11·26	31,770	30
1897	7,128	749	10·51	27,967	30
1898	5,306	508	9·57	16,618	32·71
1899	7,135	682	9·57	40,865	59·90
1900	6,544	665	10·16	40,310	60·61
1901	15,268	910	5·96	46,733	69·79
1902	26,190	1,524	5·82	76,462	50·17
1903	51,577	2,268	4·39	135,735	59·84

V.—THE MINES.

(1.)—THE HERBERTON DISTRICT.

The lodes in the neighbourhood of Herberton were vigorously worked for the first ten years after their discovery. Several shafts were sunk, reaching in the case of the Great Northern lodes to depths of 400 feet and 500 feet. During this period, according to the official returns, these lodes produced some 6,704 tons of black tin, valued at about £335,200. Of this the two lodes on the Great Northern Freehold produced 4,130 tons, and the remaining lodes 2,574 tons. Mr. Jack inspected these mines in 1883, and in his report describes some 66 different claims. At that time the deepest workings were on the Great Northern lodes, at depths of 60 feet and 124 feet. The exhaustion of the surface deposits and the difficulties generally experienced in picking up the lodes when lost, led to the gradual abandonment of most of these mines. For the next ten years, from 1891 to 1900, the return of tin amounted to only

590 tons. Lode mining practically ceased in 1899, and was not renewed till the middle of 1901. The shaft on the Great Northern "Eastern Lode" was then bailed out, and the sinking of the shaft recommenced.

This was the only mine working at the time of my visit, and consequently was the only point at which the manner of occurrence of the tin in these lodes could be studied in detail.

The lodes lie mostly among the hills to the east of the town, all within an area of about 2 square miles.

The country rock is a normal biotite granite, which is traversed by numerous dykes of a pinkish or whitish elvan. The ore bodies seem to have been exceedingly irregular in character, but to have afforded wonderfully rich ore on the whole. The total stone treated for the first ten years shows an average of black tin of over 21 per cent. for over 32,000 tons of stone. Of these lodes the St. Patrick, Bradlaugh, Southern Cross, Wild Irishman, and Black King were the better known, but as none of them had been working except occasionally in a desultory way for some years previous to my visit, I found it practically impossible to obtain any reliable information about them.

Table II. gives the official returns of ore crushed from the mines near Herberton as far as they have been recorded.

TABLE II.

Official Returns of Ore from Mines Crushing at Herberton from 1883 to 1903.

(Abstracted from Wardens' Reports.)

Year.	Total from all Mines, Crushed at Herberton Company's Mill.		Great Northern Company's Gully Lode.		Great Northern Company's East Lode.	
	Stone.	Black Tin.	Stone.	Black Tin.	Stone	Black Tin.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1883	8,950	1,889	4,500 tons of stone gave 1,240 tons of black tin from both mines.			
1884	8,965	1,509	1,400	420	600	150
1885	2,423	563	1,400	400	300	100
1886	2,869	530	800	240	180	42
1887	2,519	560	850	130	950	236
1888	2,222	506	600	180	1,000	300
1889	2,063	454	99	40	1,161	314
1890	2,550	658	...	...	1,200	336
1891	1,290	232	...	...	980	196
1892	1,451	137	...	...	...	...
1893	723	153	...	...	..	...
1894	869	128	...	...	...	...
1895	443	44	...	...	...	...
1896	583	54	...	...	...	...
1897	211	37	...	...	...	...
1898	608	37	...	...	...	...
1899-1903... ...	...	...	...	...	...	...
Totals ...	38,739	7,491	5,149	1,860	6,371	1,674

THE GREAT NORTHERN FREEHOLD.

The workings on this property, which is 60 acres in extent, are within half a mile of the town of Herberton. The ground was taken up in 1880 as Mineral Selection No. 2824, and subsequently became freehold under the old Mining Act of that date. There are two main lodes, the "Gully" lode, on Prospector's Gully, the first found in the district, and the "Eastern" lode, situated about 300 yards further up the creek, in an east-by-south direction.

The Gully Lode has been worked to a vertical depth of 550 feet, but has lain idle since 1894, the main shaft having since collapsed and become unworkable. The outcrop of the lode strikes a little east of north for a length of about 3 chains, and shows a dyke of elvan running along its eastern wall. Plans of the mine show that the lode material was associated with this elvan dyke in the lower levels, and the junction of the latter with the granite appears to have formed the line of weakness along which the mineralising agents found access from below. The official returns from this mine show a total of 1,410 tons of black tin, of a value of about £70,500 for the 515 feet of sinking. This ore was obtained from 5,148 tons of stone, showing an average of over 36 per cent. This stone was all crushed between the years 1884 and 1889. The greater proportion was obtained above the 250-feet level, after reaching which the lode became much smaller and poorer, though the stone crushed in the last three years averaged 22 per cent.

. *The Eastern Lode* has been been worked to a vertical depth of 550 feet, and during last year was again met in a drive from the main shaft, at a depth of 700 feet. The lode formed a prominent outcrop on the surface, running north and south for about 120 feet, with a width of about 18 feet at its southern end. The outcrop terminated abruptly either way, with no sign of its continuation to north or south. The outcrop ore was removed in an open quarry going into the hill in a southerly direction. This quarry has levelled the surface formerly occupied by the outcrop ore, leaving a wall of granite on the east. To the south it terminates against another wall of barren granite. The ore was stoped out by three shafts to a depth of from 50 to 80 feet. The northernmost of these subsequently became the main shaft. At a depth of 50 feet it met a flat slide dipping to the north, which cut off the tin completely below the surface workings. The north shaft was then sunk through barren ground for 100 feet before meeting good ore again at the 150-feet level. The shaft was completed to the 200-feet level in 1884, and winding machinery erected in 1886. At the 200-feet level the shoot of ore ran for about 100 feet north of the shaft, and 25 feet south of the shaft, and was from 10 to 20 feet wide, but of very irregular cross section. It was stoped on the south side of the shaft, to which it inclined steeply as it was followed up in a wide irregular stope. The slide passed through in the shaft was again met with in this stope at a point about 80 feet south of the shaft, and about 100 feet above the level. This stope, known as the "south stope," afforded an immense quantity of rich ore. Below the 200-feet level the greater portion of the ore came from north of the shaft, which was continued on vertically to the 400-feet. At the 300-feet the shoot of ore was about 65 feet in length and 10 feet in breadth, but below this point it became much smaller, and was followed down by a winze to the 400-feet level, where it was about 70 feet in length and 10 to 12 feet in width. From the 400-feet the ore was followed down by two irregular winzes to the 450-feet level, and subsequently by another irregular winze to the 500-feet level. The ore body below the 400-feet was comparatively poor and small, and was finally abandoned in 1892. The mine remained idle, except for a little tributing in the upper stopes, till 1901, when the shaft was again bailed out and sinking continued. During last year the lode was again met with at the 700-feet level, in a drive north from the bottom of the shaft.

The official returns of ore from this mine show that 6,371 tons of stone were crushed for a yield of 1,674 tons of black tin between the years 1884 and 1891. This gives an average of 26 per cent. for all stone crushed, and a gross value of about £63,700. In addition to this, a considerable amount (perhaps 2,000 tons), was crushed in 1883, of which there is no exact record.

The ore from this mine is very coarse-grained, occurring in association with quartz and a black serpentinous mineral. The lode does not occur along any well-defined course, and shows no signs of being connected with any fault or fracture in the granite. Owing to the good standing qualities of much of the ground, very little timber has been used, and consequently a great portion of the old workings can still be examined. The ore, where richest, occurred in large lumps and veins of cassiterite associated with a clean white quartz. In many parts of the mine the lode has been left as large masses of white quartz, too poor in tin to work. This white quartz is seen to pass gradually into altered granite rock, carrying less quartz, and showing serpentinisation of some of its mineral constituents. This gives rise to a dark-black amorphous-looking rock, always regarded as lode formation by the miners. As the outside edge of the lode is approached, the alteration of the granite becomes less and less, passing rapidly, but with easily recognisable gradation into the unaltered granite. The bounding-planes of the lode formation are exceedingly irregular, giving the lode a widely differing cross section at every level. The lode formation is without doubt a result of the alteration of the granite rock by the influence of mineralising agents which have been introduced into it subsequent to its solidification.

(2.)—WATSONVILLE DISTRICT.

Watsonville township lies about 5 miles due west of Herberton, on the western fall of the main divide. It is in the drainage area of the Walsh River, which flows about 2 miles to the north of it. From the time of the first discovery of the lodes on the hills to the east and south of the town, up till the year 1896, these mines were worked with great success, the annual return from the Bischoff Mill, on the Walsh River, being about 250 tons of black tin, of an average yearly value of about £10,000. The mines were mostly worked by small parties of men, holding small areas, and working with primitive appliances. The workings generally followed down narrow shoots of ore, often in a very irregular manner, necessitating two or three handlings before the ore could be landed at the surface. It had then to be carted to the mill on the Walsh River, a distance of 2 miles from the nearest mines, over bad roads. The average value of the ore for the fifteen years from 1882 to 1896 was a little over 16 per cent. for 26,531 tons of stone. Mr. Jack visited these mines in 1883, and described 36 lodes in his report on the district. Many of these were worked continuously for some years, but the greater number were gradually abandoned as the surface deposits were worked out, and the attempts to locate the lodes at greater depths became too expensive for the means at the disposal of the miners. The rapid fall in the price of tin in 1893 materially aided the gradual abandonment of the mines. At the time of Mr. Skertchly's visit in 1895 only a very few were being worked, and they only in a desultory way. The yield of tin also fell rapidly, till, for the years 1900 to 1902, it only averaged some 30 tons annually. During last year (1903), the Bischoff mill crushed 821 tons of stone for a yield of 65 tons of tin, valued at £4,854.

At the time of the writer's visit to the field, the only work being done was the stoping of ore at about 100 feet depth in the Montgomery shaft on the top of the hill, to the west of the Great Western Mine. The ore here was being followed down as a narrow shoot with a very irregular downward course by irregular workings necessitating three handlings of the ore before it reached the surface. It consisted of altered porphyry rock, silicified and impregnated with grains of tin. There were no walls to the lode, which apparently followed no defined course, the ore merging gradually on all sides into barren rock. It was evidently being followed only by the exercise of the greatest care in observing where the rock was barren and where tin-bearing.

The ore shoots in this district were apparently narrow and very irregular, both in shape and richness, at different levels. The ore seems to have occurred in bunches, elongated generally in a more or less vertical direction, and separated from each other in the vertical line by patches of barren rock which had to be sunk through before other bunches of ore could be picked up.

Their positions seem to have been determined by the jointing of the country rock, and its alteration to lode matter by the admission of mineralising agents from below.

Mr. Jack, in his report, published a map showing the topographical features of the neighbourhood and the boundaries of the different formations. Mr. Skertchly, in his report, reproduces this map, with a little added detail, and also gives considerable information about some of the most important mines, with plans showing details of the work done up to that time. Since Mr. Skertchly's visit very little work has been done on any of these mines. The lodes occur both in the porphyry on the hill to the south of the town, and in the greywackes and slates to the east. Of the former, the Caledonia, King of the Ranges, Great Western, Stewart's T., and Chance mines were the largest producers, and of the latter the North Australian group and Federation group. The greater number of the mines on the hill to the south of the town, including the Great Western, Stewart's T., Chance, and Cuprite Mines were consolidated in 1890 into one company, and an attempt made to work them again. The main adit on Stewart's T. Mine was continued towards the Great Western Mine, but apparently without finding any important bodies of ore. This work was in abeyance at the time of my visit to the field, but I understand has been resumed again since.

(3.)—THE IRVINEBANK DISTRICT.

The township of Irvinebank lies about 8 miles west-south-west of Watsonville, on Gibb's Creek. After the erection of the battery in 1884, it became one of the chief mining centres of the tinfield, and since the starting of the Vulcan Mine in 1891 it has been the leading industrial centre. The battery now consists of 30 head of stamps, with numerous dressing appliances and smelting plant attached. The Great Southern and Red King Mines lying near together about 2 miles south of the town, furnished the great bulk of the tin for the first few years, and subsequently the Old Tornado, Comet, Adventure, Pandora, Columbia, and many other smaller mines contributed largely to the returns. In 1890 the Vulcan Mine was purchased by the present company, and since then has yielded the great bulk of the tin, aggregating for the next ten years 5,066 tons out of a total of 5,730 for the whole of this district. The remaining mines all failed to afford sufficiently large bodies of ore when sunk upon to allow of their being worked to any depth. The deepest was not prospected to more than 300 feet from the surface.

The total return of stone for the district for the six years prior to the opening up of the Vulcan Mine shows an average of 11.9 per cent. tin from about 28,000 tons of stone. The Vulcan stone shows an average of 10.9 per cent. for about 55,000 tons of stone. The great size of the ore bodies, and the richness of the ore in this lode has allowed of its being worked almost continuously to the 600-feet level, notwithstanding that the lode has been several times completely lost, and only found again by persistent prospecting at great expense.

The majority of the lodes lie within a few miles of the battery round which the township has grown up. The country is rough and hilly, and the making and up-keep of roads for carting ore are expensive items. Timber for mining is abundant.

The geological formation of the country amongst which the lodes in this neighbourhood occur, is a series of folded greywackes, quartzites, and slates. These rocks strike generally about north and south, dipping at high angles, often almost vertically. The bulk of the ore deposits occur in the coarser quartzites and greywackes. They resemble those found in the igneous rocks in the manner in which lode material merges into barren rock with no break of continuity between the two, and often in the bunchiness and irregularity of disposition of the ore. This latter character is not, perhaps, so marked or so universal. The rock fractures seem, in the cases of the sedimentary beds, to have been more continuous or more closely set together, and to have allowed of the formation of more continuous shoots of ore.

The lode material is generally a fine-grained green chloritic rock, which weathers to a rusty-red on the surface, thus giving an indication to the prospector of the presence of a lode. Under the microscope it shows a complex mixture of grains of green chlorite and colourless quartz, through which are scattered grains of magnetite and crystals of tin, often massed together in bunches or along veins. This material is evidently the result of the alteration *in situ* of the original sedimentary rock by the ascension into it of mineralising agents from below. The silicate minerals have been attacked and replaced by secondary quartz and chlorite, and the tin and magnetite, with lesser amounts of bismuth sulphide, galena, and copper pyrites have been deposited amongst them.

THE VULCAN MINE.

The Vulcan Mine lies on the northern side of Gibb's Creek, about half a mile below the township of Irvinebank. The outcrop is near the eastern edge of a belt of greywacke rocks, which strike roughly north and south, and stand almost vertically. This belt of coarser-grained rocks is about 5 chains in width, and is bounded on the east and west by slates and schists.

The lode has been worked to a depth of 800 feet from a vertical shaft sunk on the edge of the greywackes, about 150 feet south-east of the outcrop of the lode, and by levels driven from the shaft at depths of about 100 feet apart.

The size and shape of the ore body vary greatly at different levels, being on an average about 40 feet in length by 20 feet in breadth, but of very irregular section. It has a general dip to the south-west at a steep angle.

The outcrop was on the eastern fall of a ridge, and was taken out by shafts sunk on the lode, and by an adit from the side of the hill about 80 feet lower down. The ore body at the outcrop measured about 38 feet in length by about 16 feet in width. The main vertical shaft was sunk from near the entrance of this adit. The shoot of ore went vertical to the adit level. It then underlay steeply to the west-north-west, following the line of strike of its greatest length, and increasing gradually in size as it was followed down. At the 100-feet level in the shaft this lode had increased to 70 feet in length by 25 feet in width. At the 200-feet level in the shaft a drive was put in to catch the shoot of ore underneath the eastern end of the stope at the 100-feet, but failed to get any tin. By the time it had been stoped down to the 180-feet level in the shaft, the ore body had opened out to 85 feet in length by 30 feet in width. It had produced 2,357 tons of black tin, valued at £65,784, from some 15,020 tons of stone, within 260 feet of the outcrop, and had paid £28,013 6s. 8d. in dividends.

Owing to the splendid standing quality of the ground in which this lode occurs, the stope from which this ore was taken remains as an enormous cavern, 85 feet in length by 30 feet in width at its base, and tapering up from the 180-feet level to the adit level 180-feet above, where the roof has been timbered over to prevent accidents from falling stones.

As the ore was carried down from about the 180-feet level, it gradually gave place to barren rock. The splendid ore body worked above gave place to a few small veins of ore leading down in different directions.

One small vein was followed down on the western end of the shoot by a winze dipping steeply to the south-west. This vein gradually opened out till at the 280-feet level—*i.e.*, 100 feet lower down, it measured 38 feet in length by 26 feet in width. Below this point it decreased again rapidly, and "petered out" entirely at the 320-feet level. A second narrow vein leading down from the north-eastern side of the 180-feet level was followed down by a winze, dipping at about 45 degrees to the north-east, at a depth of about 100 feet below the floor of the big stope; this opened out in another large body of ore which has since been worked in the adjoining Tornado Mine.

An attempt was made to pick up the lode that "petered out" at the 320-feet level in the Vulcan Mine by a drive from the shaft at the 400-feet level. This drive failed to find tin under the stopes above, and a great deal of prospecting by means of drives and crosscuts in all directions was carried out before tin was again found. Meanwhile, the ore was supposed to have completely "duffered out."

By a lucky inspiration, a crosscut was put in in a south-westerly direction, at a point where there had been a strong inrush of water in driving the level, along an open seam in the country rock, the manager suspecting that the flooding of water had some connection with the existence of an ore body in that direction. Tin was first found 60 feet west of where the lode was lost at the higher level. This prospect soon opened out into a body of ore 40 feet in length by 16 feet in width. On being stoped upwards it rapidly contracted, and 40 feet above the level had completely "petered out."

The ore body at the 400-feet level had thus apparently shifted bodily 60 feet to the south-west, with no aparent connection between the two portions, except the open seam along which the circulation of the water was taking place.

Below the 400-feet level the ore body has been stoped underhand to the 550-feet level, and has turned out an enormous quantity of ore. At the 500-feet level the still open stope measured 150 feet in length by 25 feet in width, and forms a cavern extending up to above the 400-feet level, and completely open. At the 550-feet level two horses of barren rock have come in, dividing the shoot into three ore bodies. The centre body has been followed down by a winze to the 600-feet level from the shaft, down which the ore is passed, and around which it is being stoped.

At the 600-feet level it was about 50 feet in length by 30 feet in width, and has been stoped downward for another 40 feet, when it completely disappeared in the country rock. The western shoot of ore from the big stope was followed as a narrow pipe to the 750-feet level, where it was met by a prospecting drive from the shaft, which has, however, failed to pick up any large bodies of ore. A small body met with under the eastern end of the big stope, on being stoped up for a short distance, was lost in the rising, which was broken through into the main central lode at the 550-feet. The shaft is now being sunk to the 900-feet level, with the object of prospecting for a continuation of the ore bodies at that depth.

Since its purchase by the present company this mine has turned out, up to the end of 1903, 5,964 tons of black tin, of a value of some £220,000, from above a depth of 800 feet. For the first five years during which the large ore body, from the surface down to the 180-feet level in the shaft, or 260 feet below the outcrop, was being worked, the ore averaged about 15 per cent. of black tin for about 17,000 tons of stone. Since then it has averaged about 9 per cent. of tin for about 38,000 tons of stone. Some of this latter stone has, however, been taken from that left in the upper stopes as too poor to be profitable.

THE TORNADO MINE.

The ore body worked in the Tornado Mine is apparently an offshoot of that worked in the Vulcan Mine. The vein of ore found dipping off to the north-east at the 200-feet level in the latter mine, on being followed down by means of a winze, opened out into a body of ore some 100 feet in length by 20 feet in width, and 40 feet in height. This ore has all been removed and crushed, leaving an immense cavern with walls, roof, and floor of barren greywacke rock. The Mines Department records do not show the amount of ore that has been taken out of this hole, but it must have been very considerable. Below it no tin has as yet been found, though at 100 feet below a level has been driven right under the ore body, and crosscuts have been put in right and left, at different points, in attempts to again pick up the lode.

During 1901 and 1902 the amount of stone crushed was 5,212 tons for a return of 425 tons of black tin, worth £18,490.

THE GREAT SOUTHERN MINE.

This mine lies about 2 miles south of Irvinebank. The workings extend along the outcrop of a belt of greywacke striking about north and south, and dipping to the west. On either side are fine-grained compact slates. The main outcrop, on which the main shaft has been sunk to a vertical depth of 390 feet, was taken out on the surface as a huge quarry from which a great quantity of ore was obtained. The shaft followed this body down in the underlie, dipping north-west at about 60 degree from the horizontal. At the 130-feet the lode was lost in the shaft, which passed into the underlying slates. The mine lay deserted for many years, but latterly the shaft has been again sunk to the 290-feet level, and crosscuts to the north-west at the 190 and 290-feet levels found the lode at about 30 feet from the shaft, and a large amount of ore has been stoped out between these two levels. A subsequent drive from the 350-feet level found a little ore, which was followed down for another 40 feet, but proving too poor to be payable the mine was closed down in September of this year.

Since 1901 2,359 tons of stone have been crushed from these lower levels for a return of 110 tons 18 cwt. of tin, valued at £6,268.

About 150 feet north of these workings another shoot of ore, known as No. 3 workings, was worked down to the 130-feet level, and connected by a level with the main workings, and seems to have afforded large bodies of ore, judging from the open stopes still left.

Numerous shallow workings extend north from the Great Southern shaft to the Red King Mine, some 14 chains off. These workings lie along a line roughly parallel with the strike of the greywacke rocks in which they occur. At the

RED KING MINE

the lode has been worked for a length of about 200 feet down to the lowest level at which an adit could be brought in from the base of the hill. Below this level the lode appears to have been lost. The old workings show that the course of this lode was here more regular in character than is usual in this district. They can be followed between the still standing walls of the lode, which dip a little to the west, and are in places 10 or 12 feet apart, and show evidence that the lode material was almost entirely confined to the space between them. There are no official records of the amount or value of the ore crushed.

THE ADVENTURE MINE.

The Adventure Mine lies about 3 miles due south from Mount Albion, and about the same distance south-west of Irvinebank. The lode outcrops along the top of a ridge striking in a north-westerly direction, and dipping at about 60 degrees to the south-west. It has been worked down to a depth of about 150 feet below the top of the ridge by means of two shafts and an adit at the lower levels. The lode material is a soft white kaolin binding fragments of rock, and occurs between two well-defined walls which run in a regular course, and are apparently the result of faulting of the country rock. There were apparently two shoots of rich ore, the north-eastern one of which was taken out for a length of about 60 feet, and to a depth of about 240 feet, where it was met by the tunnel. The south-eastern shoot was worked down to about the 200-feet level. There is no official record of the amount of stone crushed or tin obtained from this mine.

THE PANDORA MINE.

At this mine a body of ore was found outcropping on the southern slope of a hill some 3 miles north of the township, in greywacke rock, close to its junction with slates, both dipping at an angle of about 45 degrees in the direction of the slope of the hill, with the slates overlying the greywackes. The slope of the hill was about 60 degrees, and the ore was worked down by means of shafts and an adit from the side of the hill as it followed the junction-line between the two rocks, to a depth of about 120 feet from the outcrop. The shoot of ore ran for about 100 feet from the contact of the shales, and is said to have given 20 tons of 10 per cent. ore in the last 60 feet of sinking.

None of the mines in this neighbourhood, except the Vulcan and Great Southern, were being worked at the time of the writer's visit, and as there are no official records of the individual returns of the various mines, it is difficult to form any opinion as to their value. The fact, however, that the average value of the ore raised was nearly 12 per cent. shows that although a great many of the shoots of ore were comparatively small, they must have been very remunerative in the shallower levels.

(4.)—EUREKA CREEK DISTRICT.

These mines were worked during the years 1888 to 1893, and the stone crushed at a battery erected on Eureka Creek, a little above the Ivanhoe and Eclipse Mines. During the first three years 3,546 tons of stone were crushed for a return of 392 tons of black tin, of a value of about £20,000, and an average value of about 11 per cent. tin. There are no records of the amounts crushed in 1891 and 1892, but apparently there was very little ore raised. The mill was hung up during the greater part of 1891, and the mines are not referred to in the Warden's report from the field in 1892. In 1893, 377 tons were crushed, and yielded 54 tons of black tin, an average of 14 per cent. By this time the best of the easily-obtained ore had been worked out, and the mines proved unpayable at the low prices then obtainable for tin without the introduction of capital for further development. The mill was removed to another portion of the field in the latter part of 1893, and the mines were practically abandoned.

In 1899 a number of these lodes were taken up again by the Stannary Hills Company, and a 20-head battery was erected on the Walsh River, 5 miles to the east. The mines were connected by a 2-feet gauge tramline with the battery, and also with the Chillagoe Railway line, at its crossing of Eureka Creek, 14 miles further down the creek. The line was completed in 1902, and the battery commenced crushing in August, 1903.

THE STANNARY HILLS COMPANY'S MINES.

The mines being exploited by the Stannary Hills Company lie in a series of greywackes and slates near the head of Eureka Creek. These sedimentary rocks cover an area about 3 miles long and 1 mile broad, and are surrounded on all sides by granitic rocks. The ore deposits are almost entirely confined to the coarser beds of the series. The most important lodes lie along the outcrop of a belt of felspathic greywacke standing vertically between beds of soft fissile slates. The belt of greywackes is about 800 feet in thickness, and strikes in a north-westerly direction across Eureka Creek. The Ivanhoe, Eclipse, Monarch, Extended, and Black Rock Mines lie along this belt over a length of about a mile. They are the only ones that have been worked by the present company. Further south are the Hornet's Nest group, and other lodes, all apparently on the same line of outcrop of greywacke rocks.

The Ivanhoe Mine lies on the southern bank of Eureka Creek, the outcrop of the lode being about 100 feet above the creek bed. The ore body had been stoped out down to the level of the creek by means of tunnels driven in from the bank. These workings left a pipe-like excavation of roughly oval section, measuring from 15 feet by 9 feet in its narowest portions to 20 feet by 15 feet in its widest. A shaft was then sunk from the surface, from a little north of the ore body to a depth of about 200 feet, and the ore worked out to that depth. The ore from this working is said to have given a return of about 13 per cent. of black tin.

The memorandum-book of the Bischoff-Herberton Tin Mining Company showed that 835 tons of ore were crushed from these workings for a return of 61¼ tons of black tin, showing an average of 7 per cent. Other old workings are found along the same belt of country, the most important being the Black Rock workings, lying some 14 chains north of the Extended, and the Eclipse workings, some 8 chains east from the Ivanhoe.

At the 290-feet level the ore body was met with 50 feet north from the shaft, and was being driven on at the time of my visit. It was then proved for 18 feet in length, and was estimated to show 2,000 tons of 9 per cent. ore above this level.

On the Extended workings, the Kitchener shaft had been sunk vertically a depth of 268 feet, and joined with a tunnel 660 feet in length, coming in from the west from the bank of the Eureka Creek. Ore was found in this mine at the 105-feet level, 18 feet south of the shaft, and for a distance of 15 feet. Its width was not proved. It was estimated to be worth 9 per cent. The ore body had not been found at the 180-feet level.

The Extended shaft, about 130 feet north-west of the Kitchener shaft, had been sunk vertically to a depth of 186 feet. The ore body had been found in a drive about 80 feet north from the 120-feet level, and a winze sunk on it for 60 feet. At 30 feet down it was estimated to be 70 feet long by 40 feet in width. The 186-feet level had not reached the ore body.

The ore bodies in this district resemble in character those found at Irvinebank. Their extreme irregularity, both of shape and in value, when traced from point to point, makes the estimation of quantities of ore developed, or likely to be developed by further working, a matter of the greatest difficulty, and makes the opening up of fresh ore reserves well ahead of the requirements of the battery a *sine qua non* of economic mining here as elsewhere in this district.

The proper opening up and proving of their ore reserves by the Stannary Hills Company had, up to the time of the writer's visit, been subordinated to the construction of the tramline and the erection of a battery. By the time that the battery was ready to commence crushing, the company's workings, described above, were quite inadequate to keep it fully supplied with ore, and the company was hampered by lack of funds for further development. Since commencing crushing in August up till the end of the year, the mill put through 5,660 tons of stone for a return of 210 tons of black tin, showing an average of 3.71 per cent. This return is most disappointing, considering the high assays reported from time to time, and the capacity of the mill, which should be capable of putting through over 3,500 tons a month.

(5.)—THE KOORBOORA DISTRICT.

These mines were reported on by Dr. Jack in 1890. At that time they were being prospected by Messrs. John Moffatt and Co., of Irvinebank, the ore being packed into Irvinebank, a distance of 30 miles, to be crushed. In 1899 a mill was erected near the Shakespeare Mine, and crushing has been fairly continuous since the beginning of 1900. The Shakespeare Mine has contributed the bulk of this ore, especially during later years.

The ore deposits occur in a series of hardened sandstones and mudstones.

The shoots of ore in this district appear to be small, but the average value of the ore is fairly high. They are, however, very bunchy, and hard to follow.

The Shakespeare Mine.

The main ore body was taken out to the 60-feet level for 50 feet in length by about 8 feet in width. This ore body dipped to the west, and was met at the 100-feet level by a crosscut east from the vertical shaft, 20 feet in length. At this point the ore body was stoped out for 30 feet in length by 14 feet in width and 20 feet in height, but above that, to the 60-feet level, it was barren of tin, or too poor to work.

The crosscut at the 200-feet level met a large body of low grade ore, 20 feet in width, at 80 feet east of the shaft, the lode having apparently turned over to the east. On the eastern wall a seam of good tin was ready for stoping.

A second shaft, 215 feet south of these workings, passed through a shoot of ore which was taken out for about 20 feet in length and 5 feet in width, down to the 60-feet level. Below this a drive north from 70 feet depth in the shaft passed through the same chlorite formation, but here it was barren of tin.

The Portia Shaft.

The Portia shaft is about 300 yards further south, and followed down a roughly circular-shaped ore body to the 100-feet level. The lode was being stoped above that level.

The battery here has been kept going by numerous small mines in the neighbourhood, none of which have as yet developed any very important bodies of ore. Since the completion of the battery in 1900 to the end of 1903, 11,598 tons of stone have been crushed for a yield of 341½ tons of black tin, valued at £19,416. This gives an average value of £1 13s. 6d. per ton for all ore crushed.

(6.)—NEWELLTON DISTRICT.

THE LAUNCELOT MINE.

This mine was discovered about 1895 by Harrod Brothers. It was visited by S. B. J. Skertchly in that year, when three shafts had been sunk on the lode, along a length of about 100 feet, and to depths of 35 feet, 40 feet, and 53 feet. The lode had also been traced for about 200 feet north-west of the workings by two shallow shafts. In 1899 the mine passed into the hands of a German company. The ore shoot on which the three shafts described by Mr. Skertchly were sunk, has been followed down by sinking the two extreme shafts to the 150-feet level. These have been connected at that level, and the level continued along the lode for 200 feet north-west. The ore shoot at the 150-feet level has proved continuous for a length of about 210 feet north of the No. 1 shaft. It was being stoped up from this level at the time of my visit, and had been carried up a height of about 45 feet. At the north-western end of this shoot—*i.e.*, 210 feet from the No. 1 shaft, the lode pinched out and the formation took a bend to the west. It was driven on to a distance of 270 feet, where the lode had been followed down from the surface by an inclined shaft. In the stoped-out ground the reef has averaged about 3 feet in width, and has returned nearly 12 per cent. over a length of about 200 feet. Up to the end of 1903 the present company had crushed 4,190 tons of stone for a return of 494 tons of tin, valued at £28,234, or an average value of £6 14s. 7d. per ton.

The lode occurs in a series of quartz and clay schists, and strikes parallel to the bedding. The gangue is siliceous, and the mineral is evenly distributed through it, mixed with a considerable amount of copper pyrites and metallic bismuth. Unlike the majority of the lodes in this district, this lode runs with a fairly regular course between well-defined walls, the lode material, or gangue, being separated by well-marked planes of division from the barren country rock on either side. The present company have continued the No. 2 shaft to the 200-feet level, and are developing the lode at that depth.

OTHER LODES NEAR NEWELLTON.

South of the Launcelot Mine are several other lodes which have as yet received very little attention, but have lately been secured by the Launcelot Company, and will shortly be developed. Of these the most important are the Freehold lode, about half a mile further south, and the Magnum Bonum lode, about 3 miles to the south.

(7.)—COOLGARRA DISTRICT.

These lodes were prospected in the early years of the field, parcels of picked ore being bagged and sent away to distant batteries. In 1885 a battery was erected on Return Creek, and during the next four years 3,845 tons of stone were crushed for a yield of 272 tons of tin, an average of 7 per cent. The mines remained unworked from 1889 till 1899, when the Coolgarra Company was formed to take over most of the mines in the neighbourhood, and the erection of a new 10-head battery was put in hand. Crushing commenced in January, 1901, and proceeded continuously till September, 1903.

The lodes at Coolgarra lie in the sedimentary rocks close to their contact with granite porphyry. The main producers since the present company began work have been the Alhambra Nos. 1 and 2. At the time of the writer's visit the Alhambra No. 2 was the only mine being worked, the remaining mines having all been closed down.

The Alhambra No. 2 is situated on the western face of a hill immediately to the east of the township, and is connected by a tramline with the mill on a branch of Return Creek, about half a mile further east. The ore occurs as irregular shoots in a coarse greywacke, similar to that found at Irvinebank and Stannary Hills.

The old workings followed the best of the ore down to the 110-feet level, and a tunnel, driven in a north-north-east direction from the side of the hill, met the bottom of the shaft. At this point the present company took out a large body of ore. A drive put in to the north-west met another large body in 40 feet, which was worked out as a large open cavern 40 feet in length by 20 feet across, extending to the surface, and which furnished the greater portion of the crushings in 1902 and 1903.

To meet this shoot of ore at a greater depth No. 3 shaft was sunk about 125 feet north-west of the old shaft, but after 40 feet of stoping underhand the No. 2 shoot gave out altogether, and was replaced by greywacke rock.

No. 3 shaft was sunk to the 255-feet level, and a crosscut to the south-east, towards the No. 2 shoot, met a third shoot of ore within a few feet of the shaft. On stoping up, this body of ore became too poor to work, but was carried down and met again in sinking the shaft another 100 feet. The ore body was being risen on from the 355-feet level at the time of my visit, but proved too poor to be profitably worked, and the mine was closed down in September. During 1903 this mine crushed 7,726 tons of stone for 127 tons of black tin, valued at £5,595, or an average of under 14s. per ton.

During 1902 the amount crushed was 11,158 tons for 257 tons of black tin, valued at £13,800, or an average of £1 4s. 8d. per ton. About 9,019 tons of this came from the Alhambra No. 2 Mine, the remainder being from the Alhambra No. 1, or small lots from some dozen or so other lodes scattered about the district.

The Alhambra No. 1 is a lode of the same character, lying on the same belt of rocks, north of the No. 2. It furnished about 1,090 tons of ore during 1902, but was then abandoned.

The remaining mines of the district afforded small parcels of somewhat richer ore than that found on the Alhambra Hill, but none of them have been worked to any depth.

(8.)—THE SMITH'S CREEK MINE.

This mine was discovered during the latter part of 1901. It lies about 7 miles north-west of Mount Garnet township, and 1 mile north of the railway line to that place.

The country rock is a grey biotite granite, which shows evidence of weathering at 100 feet below the surface in the main shaft. The main ore body has been taken out at the 100-feet level for 78 feet in length by 35 feet in width. It has been worked from a vertical shaft sunk a few feet south-west of the main shoot of ore, and by a main drive which runs parallel to the course of the lode at the 100-feet level in a south-easterly direction. Crosscuts were driven at distances of 60 feet and 110 feet south-east of the shaft in a north-easterly direction to intersect the lode.

At a point 182 feet south-east of the shaft the level takes a bend to the east and meets another ore body, which at this level was 31 feet in length by 16 feet in width. This body had been followed down by an inclined shaft from the outcrop.

The main shoot was being worked by overhand stoping from the 100-feet level up, at the time of the writer's visit, and has since been all taken out to the surface. On sinking a winze on this ore body at the 100-feet level the ore passed into granite rock, and the shares immediately collapsed. The company have since stoped out all the ore above the 100-feet level, and have no reserve of ore developed below. They have since commenced to sink their shaft and to crosscut at different levels, with a view of prospecting for further deposits of ore. Meanwhile, the mill is idle till further supplies can be found.

The ore in this mine occurs as coarse grains of tin through the altered granite rock. In all, some 18,764 tons of stone have passed through the mill for a yield of 585 tons of black tin, valued at £41,093. A considerable portion of this tin was obtained from the sluicing and subsequent crushing of the surface sheddings from the lode. As there is no separate return of the amount so derived the returns are vitiated as an index of the value of the ore mined. The above figures give an average of 3.12 per cent., but the actual value of the lode material must have been considerably less.

The history of the sudden collapse of this mine in public estimation is an example of the effects of not attempting to keep development of fresh ore reserves well ahead of the extraction of that already in sight. The evil effects in this case have been somewhat mitigated by the setting aside of a small reserve in cash, which is now available for further prospecting.

(9.)—CALIFORNIA CREEK AND REID'S CREEK LODES.

A battery was erected on California Creek, just below the present crossing of the railway line to Mount Garnet, in 1888, but, according to the warden's report for the following year, the crushings were too poor to be profitable, and the mines were closed down. The lodes lie about a quarter of a mile to the west, and were connected with the battery by tramline. They occur near the eastern edge of a patch of greywacke rocks, close to their junction with the granite, and the remains of several old shafts and poppet heads are still to be seen. There are no records of the crushings from these lodes. At Reid's Creek the lodes were in granite.

THE VILLAGE BLACKSMITH LODE.

The Village Blacksmith lode outcropped on the northern face of a hill above Reid's Creek. Two tunnels were put in along the lode, the eastern at a slightly lower level than the western, and the ground between has been all stoped out. The tunnels are about 40 feet apart, and go in for about 50 feet. The ore in this lode lay along a flat seam in the granite, apparently a contraction fracture caused by the shrinking of the granite during cooling. It was cut off along the line of the eastern tunnel by a vertical joint plane, but tin is still showing on the other side of this break, and should be worth prospecting. The ore occurs as an altered form of the granite, splashed through with crystalline tin. It is said to have been very rich.

Within the last year several promising-looking deposits have been found in this neighbourhood, but at the time of the writer's visit they were in too undeveloped a state to allow of any opinion being formed as to their value.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY OF QUEENSLAND.

Publication No. 194.

REPORT.

CERTAIN IRON ORE, MANGANESE ORE, AND LIMESTONE DEPOSITS

IN THE

Central and Southern Districts of Queensland.

(WITH 27 MAPS AND PLANS AND 16 PLATES.)

By LIONEL C. BALL, B.E.,

ASSISTANT GOVERNMENT GEOLOGIST.

◆

Page vii., line 53, *for* " Plate 5," *read* " Plate 14."

Page 21, line 37, *for* " glanconitic," *read* " glauconitic."

Page 22, Map 11, In reference—

After " Ipswich Beds," *read* " Upper Trias-Jura."
After " Burrum Beds," *read* " Lower Trias-Jura."
After " Desert Sandstone," *read* " Upper Cretaceous."

Page 25, line 30, *for* " *See* Map 6," *read* " *See* Plan 13."

Plate opposite page 40, *for* "Plate 5," *read* " Plate 14."

Page 66, line 14, *for* " castern at," *read* " eastern and."

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BRISBANE:
AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1904.

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LETTER OF TRANSMITTAL.

◆

Geological Survey Office,
Brisbane, 12th May, 1904.

SIR,—I have the honour to forward for publication a report by Mr. L. C. Ball on "Certain Iron Ore, Manganese Ore, and Limestone Deposits in the Central and Southern Districts of Queensland."

The work entailed in the preparation of the report has extended over many months, and a great number of localities have been inspected with the view of obtaining all necessary information. Much more requires to be done, however, in the Northern districts of the State, and it is to be hoped, in view of its importance, that facilities will be granted to have the work completed later on.

A Royal Commission was appointed by the Governor-General to report on the Bonuses to Manufacturers Bill, and three sittings were held in Brisbane on 1st and 2nd May, 1903. Evidence was given on the occurrence of deposits of ores of iron, chromium, wolfram, molybdenum, coal, and of limestone, and the witnesses examined were Captain Richards, of Mount Morgan, Mr. W. Fryar (Chief Inspector of Mines), Mr. J. Hargreaves (mining surveyor), Mr. L. C. Ball, and myself.*

The whole of the evidence showed conclusively that Queensland has vast resources in the raw material required for iron and steel manufacture, and in this Report—so far as iron, manganese, and limestone in the Central and Southern districts are concerned—Mr. Ball has given the details of what, at that inquiry, was only shown in outline.

I have, &c.,
B. DUNSTAN,
Acting Government Geologist.

The Under Secretary for Mines,
Department of Mines, Brisbane.

---

* The Parliament of the Commonwealth of Australia. Report from the Royal Commission on the Manufacturers Bill, together with the Proceedings, Minutes of Evidence, and Appendices. Fcap. By Auth.: Melbourne, 1904; p.p. 194.

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GEOLOGICAL SURVEY OF QUEENSLAND

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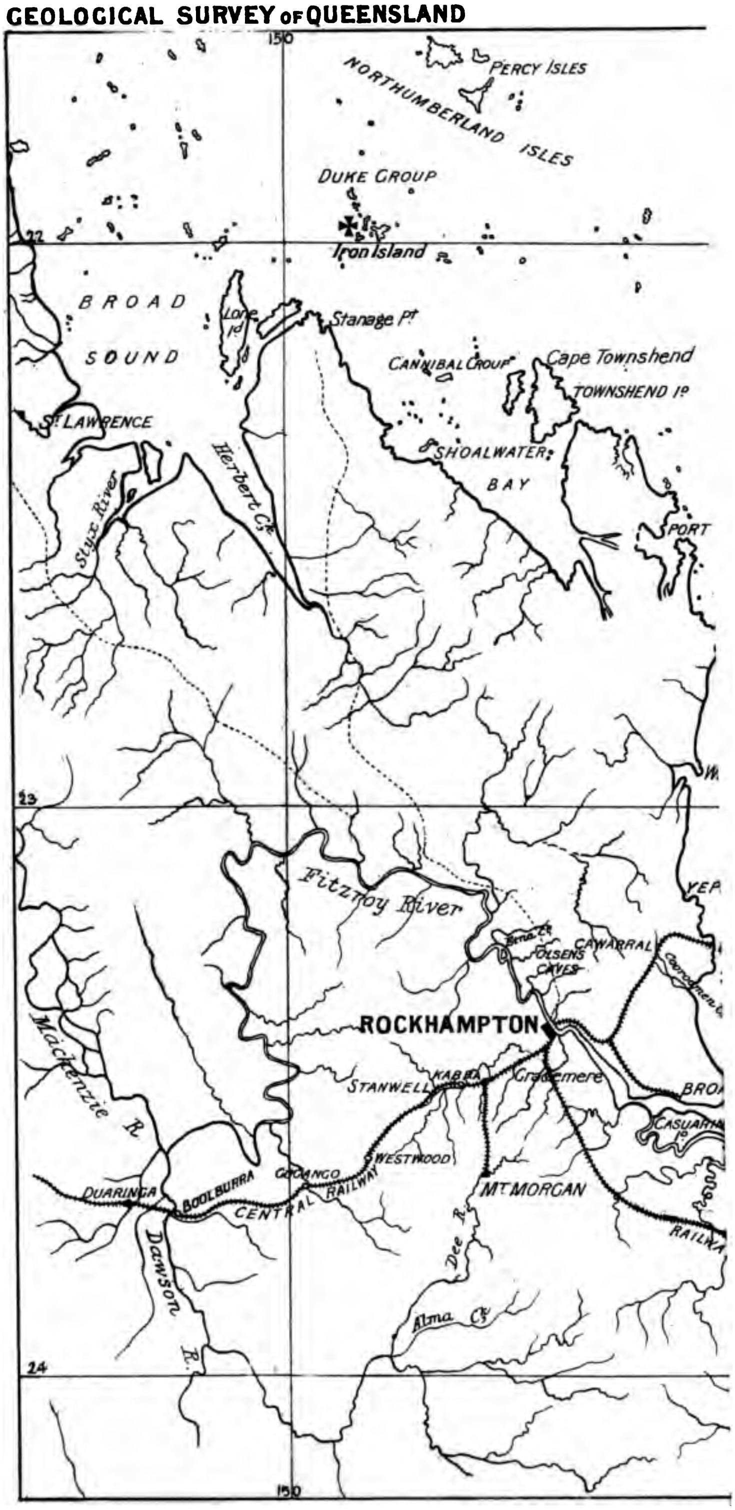

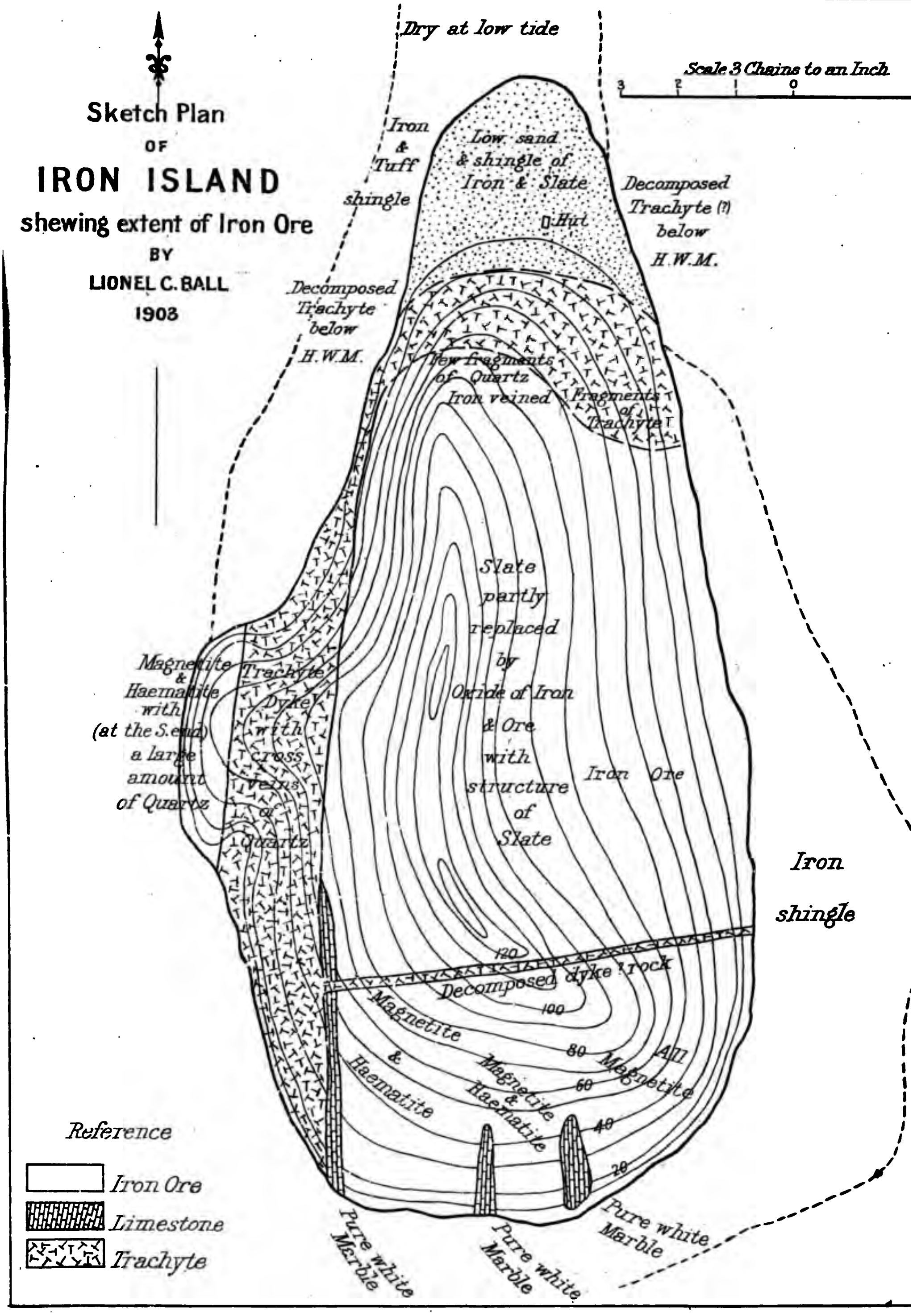

Sketch Plan OF IRON ISLAND shewing extent of Iron Ore BY LIONEL C. BALL 1903

Dry at low tide
Scale 3 Chains to an Inch
3 2 1 0
Iron & Tuff shingle
Low sand & shingle of Iron & Slate
Hut
Decomposed Trachyte (?) below H.W.M.
Decomposed Trachyte below H.W.M.
Few fragments of Quartz Iron veined
Fragments of Trachyte
Slate partly replaced by Oxide of Iron & Ore with structure of Slate
Iron Ore
Iron shingle
Magnetite & Haematite with (at the S. end) a large amount of Quartz
Trachyte Dyke with cross Veins of Quartz
Decomposed dyke rock
120
100
80
60
40
20
Magnetite & Haematite
Magnetite & Haematite
All Magnetite
Pure white Marble
Pure white Marble
Pure white Marble
Reference
Iron Ore
Limestone
Trachyte

Plate 1 a.

Photo., L.C.B. IRON ISLAND.

(*Viewed from the East.*)

Plate 1 b.

Photo., L.C.B.

Block of Magnetite with the Structure of Slate, Iron Island.

CERTAIN IRON ORE, MANGANESE ORE, AND LIMESTONE DEPOSITS IN THE CENTRAL AND SOUTHERN DISTRICTS OF QUEENSLAND.

◆

I.—ROCKHAMPTON DISTRICT.

A—Iron Ore Deposits.

The deposits in the Central District were hurriedly inspected with a view to giving information to the Iron Bonus Commission sitting at the time, and it will therefore be necessary for more detailed work to be done as time permits, at least in the case of Iron Island and the Dee River deposits.

It has been considered advisable in describing the deposits to work from north to south, and in that order the descriptions will be found in the following pages. (*See* Locality Map 1.)

I.—IRON ISLAND.

Locality.—Iron Island, one of the smallest of the Duke Group in the Northumberland Islands, is about forty miles north-east of St. Lawrence, and midway between Rockhampton and Mackay. It lies just south of the north-western headland of Marble Island, with which it is connected at low tide. There is deep water on the south, south-east, and south-west, and an anchorage in five fathoms between it and Marble Island on the south-east. (*See* Plan 2 and Plate 1A.)

The island is now held as a mineral lease at a yearly rental of 10s. per acre. No previous official report has been made on the island, but Dr. Jack, in a map accompanying a "Report* on the Geological Features of the Mackay District," 1887, shows rich hæmatite on Iron Island. He paid a brief visit to the Duke Group, and described the limestones. Owing to the very brief time spent here, the present report must be looked upon as only preliminary.

Extent.—The island is 20 chains in greatest length and eight chains in greatest width, and the whole, except a strip of one to two chains wide on the west and a sand flat five chains across on the north, is iron ore. The highest point of the island is 120 feet above high-water mark.

Taking the specific gravity of the ore as 4.5, there will be 3.4 tons per cubic yard, and the amount of ore above high-water mark will be 1½ million tons. The additional ore between the tides (23 feet) will amount to three-quarters of a million tons, making a total of 2¼ million tons of available ore.

It is, of course, possible that there may be slate in the interior of the hill, but that can only be proved by adits or shafts.

Geology.—The rock on the western side of the island is greenish, highly-altered trachyte, in which there has been a great development of east and west cross quartz veins, probably formed before the iron was introduced into the adjacent country. On the south side of the island are three outcrops of pure white statuary marble, from 10 to 20 feet across and from 20 feet to a chain in length. The ore has, in my opinion, metasomatically replaced limestone and slate (*see* Plate 1B), and the formation of ore may be still going on, for the ridge top supports figs and scrub vegetation, showing that spring water is still reaching the surface. The ore may, therefore, be expected to continue to some depth.

---

* G.S.Q. Publication No. 39.

Ore.—The ore consists in greater part of cryptocrystalline magnetite, with massive hæmatite, and scarcely a trace of visible impurity. Its specific gravity is 4.5 to 4.6. Blocks of ore up to 10 feet in diameter, weathering with every appearance of slate, are piled up round the base of the island, as seen in the accompanying photographs. (Plates 2 and 3.)

A rough surface sample was taken from the whole of the iron ore area, and its analysis is given below, together with that of a single specimen from the south side of the island.

	SAMPLE (Mount Morgan Co.'s Analyst).*	SPECIMEN (Government Analyst).
Water	0.13	0.46
Silica	2.51	1.73
Alumina	2.95	2.71
Iron	64.72 equivalent magnetite 89.73	63.94 equivalent hæmatite 91.34
Manganese	—	—
Lime	2.85	5.53
Magnesia	1.07	trace
Phosphorus	0.065	trace
Titania	—	—

These show the silica to be phenomenally low. The phosphorous is, however, too high (in the sample) for the Acid-Bessemer process, but it must be remembered that this is a general sample. On thoroughly sampling the whole island it would probably be possible to eliminate the phosphoric portion. The Lake Superior ores range from 0.009 to 0.067 per cent. phosphorus, so that a separation has to be made even there. The percentage might be reduced by mixing with other ores low in phosphorus.

Workings.—No work has yet been done on the island. There will be no difficulty in working down to tide level, but to work below, a wall of ore would have to be left to prevent the entrance of the sea water.

Treatment.—On Marble Island there is plenty of room for the erection of furnaces to which the ore could be conveyed by way of a viaduct across the channel between the two islands.

Either coal or coke might be brought there from Rockhampton, Burrum, or Ipswich, necessitating carriage by train of 90, 18, and 22 miles, and by boat of 150, 300, and 500 miles respectively. Were the cokes equal in quality it would be therefore cheaper to obtain supplies from the Burrum or else from Ipswich.

Alternative sites that have been suggested for furnaces are St. Lawrence, Broadmount, Port Alma, and Gladstone.

On the Styx River (St. Lawrence) Coal Field, which covers an area of 156

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* Advantage was taken of Captain Richards' disinterested offer to have the analyses made at the Mount Morgan works because of the necessity of having them done immediately.

Plate 2.

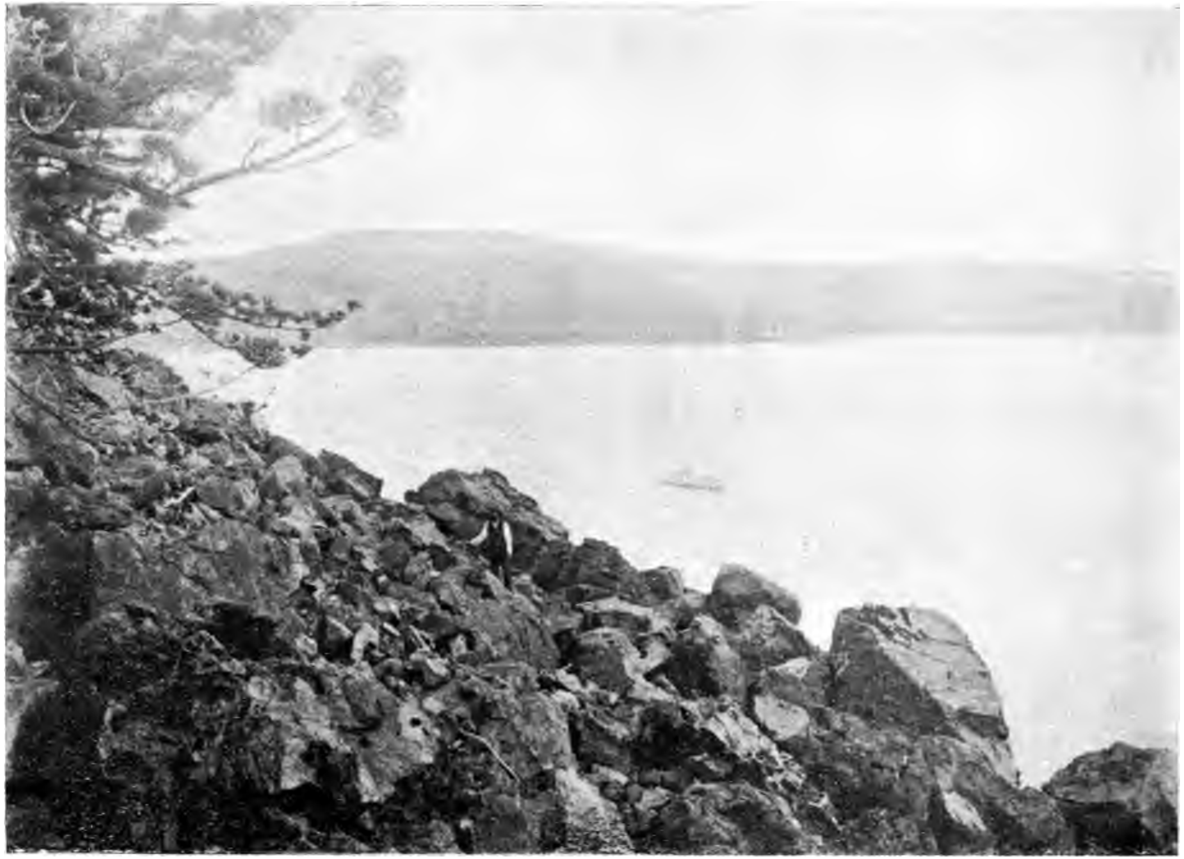


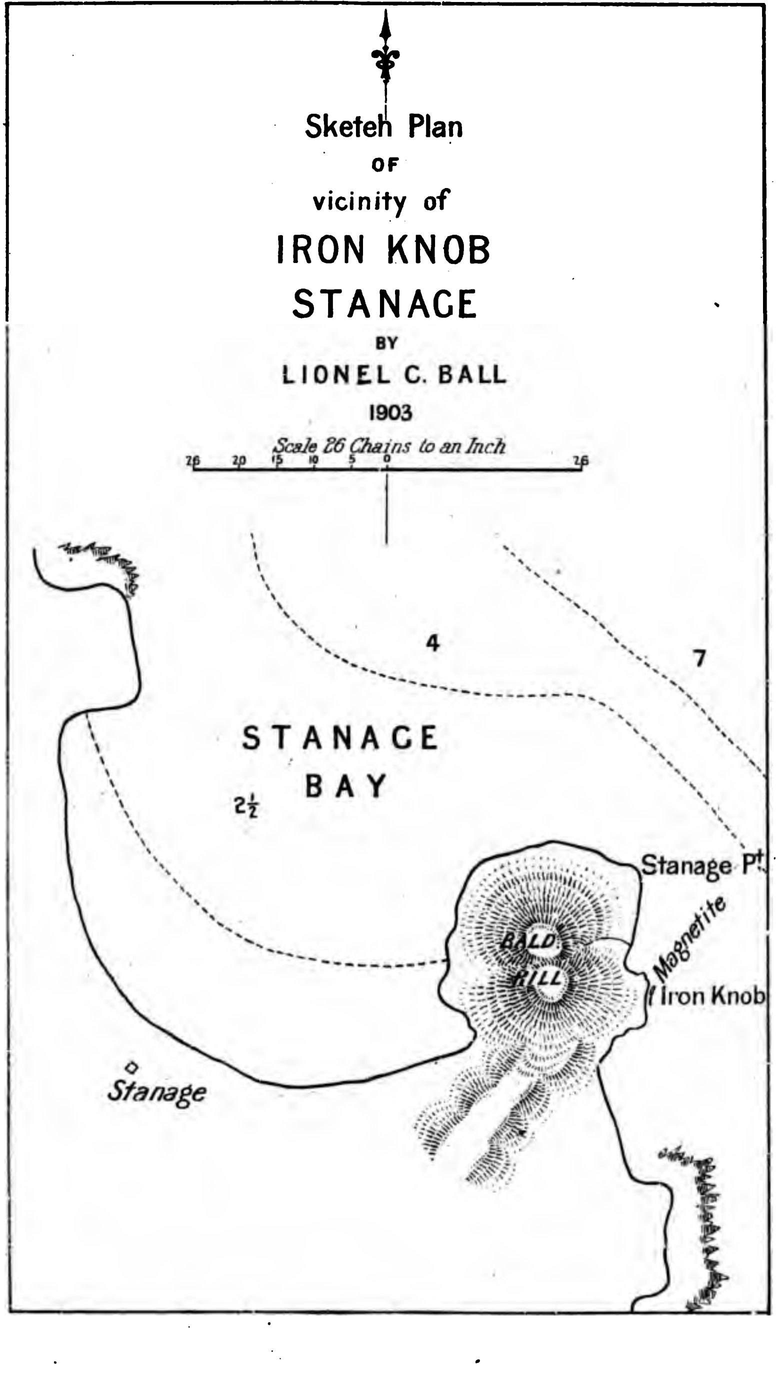
Photo., L.C.B. IRON ORE TALUS, ABOVE TIDES, SOUTH-EASTERN END IRON ISLAND.

(*Marble Island in the distance.*)

Photo., L.C.B.

Iron Ore Shingle, between Tides, South-eastern End Iron Island.

GEOLOGICAL SURVEY OF QUEENSLAND **PLAN 3**



Sketch Plan
OF
vicinity of
IRON KNOB
STANAGE
BY
LIONEL C. BALL
1903
Scale 26 Chains to an Inch

square miles, there are several small seams, and one, at Waverley Creek, showing 4 feet 11 inches coal and two bands amounting to two feet. The coal contains:

Water	2.3	per cent.
Vol. Hydrocarbons ...	22.89	„
Fixed Carbon ...	63.11	„
Sulphur	0.55	„
Ash	10.78	„

but it does not appear to coke.* The workings are some eight miles from Broad Sound, and the distance from Iron Island is 60 miles. There is difficulty in navigating this part of the coast owing to the shoals.

Broadmount, at the mouth of the Fitzroy River, 150 miles from Iron Island, is already connected by rail with the Central District Coalfields, whence either coke or semi-anthracitic coal could be brought. This would, however, require a train journey of at least 100 miles. The coal has hitherto been believed to be wholly semi-anthracitic in character, but quite lately certain seams have been proved to yield coking coals. The following is a typical analysis of coal hitherto raised†:—

Water	3.75	per cent.
Vol. Hydrocarbons ...	12.98	„
Fixed Carbon ...	78.45	„
Sulphur	trace	
Ash	4.84	„

Manganese ore occurs at Coorooman (27 miles distant by rail), and limestone could be brought in tugs from 20 miles up the river, where there are large beds, or else from the immense deposits on Raglan Creek, 20 miles to the south.

Port Alma might be connected with both Rockhampton and Gladstone; but it is understood that it is difficult, if not impossible, to obtain foundations in the alluvial, and the erection of furnaces near the wharves is therefore not practicable.

At Gladstone, on Port Curtis, there are besides immense supplies of limestone (20 miles up the Calliope River), manganese, and a certain amount of iron ore, and it has been proposed to construct a railway to the Callide Coal Field, whence coal could be brought. It has not been proved that this is a coking coal, though there is probably coal that will coke on the field.

II.—STANAGE.

Locality.—Stanage Point is near the northern extremity of the large peninsula (county of Palmerston), lying midway between Rockhampton and Mackay. The nearest town is St. Lawrence, which lies 37½ miles distant to the west-south-west across Broad Sound. Stanage Bay, to the north of the point, gives an anchorage (2½ fathoms) in fair weather. Sufficiently deep water (2½ fathoms) for loading reaches close up to the shore at the mine. (*See* Plan 3.)

Iron Knob, as the deposit is called, rises to a height of 30 feet directly from the beach on the eastern side of Bald Hill.

---

* Report on the Styx River Coal Field. By W. H. Rands. Bris.: By Auth., 1892. G.S.Q.P., No. 84.

† Report on the Geology of the Dawson and Mackenzie Rivers, &c. By B. Dunstan. Bris.: By Auth., 1901. G.S.Q.P., No. 155.

Dimensions.—The width of ore varies between six and ten feet for a distance of 50 feet, and it can be traced for a further distance of 25 yards to the south.

Ore.—On the surface the ore is black pulverulent magnetite, with a certain amount of hæmatite, and its specific gravity is 4.5. It is somewhat veined by quartz, and contains a small amount of copper ore in scattered bunches, probably less than two per cent. even in the richest places. In these bunches the chalcopyrite occurs as fine threads and grains, gradually fading into the magnetite.

An analysis (Mount Morgan analyst) of a surface sample of the ore gives:—

Iron	60 per cent.
Phosphorus	Nil.

The ore from a depth is massive, has a purplish tint, and is freer than the surface stone from quartz veins. That from the underlie shaft mentioned below contains veins of greenish magnesian silicate, usually seen in altered slate, and on fractures a thin layer of mammilated hyalite is often developed, especially where there is a trace of chalcopyrite.

The limit of the deposit is well-defined on the west, but the country on the east is veined and laminated with ore for a few feet; and, as specimens can be obtained both from the shafts and the surface showing indistinctly the structure of slate, it may be taken that the ore has replaced quartz-veined country, probably on the eastern side of a fissure. The main portion of the lode strikes north-north-east, and seems to cross the bedding of the country, but the remainder bends round almost to north and south.

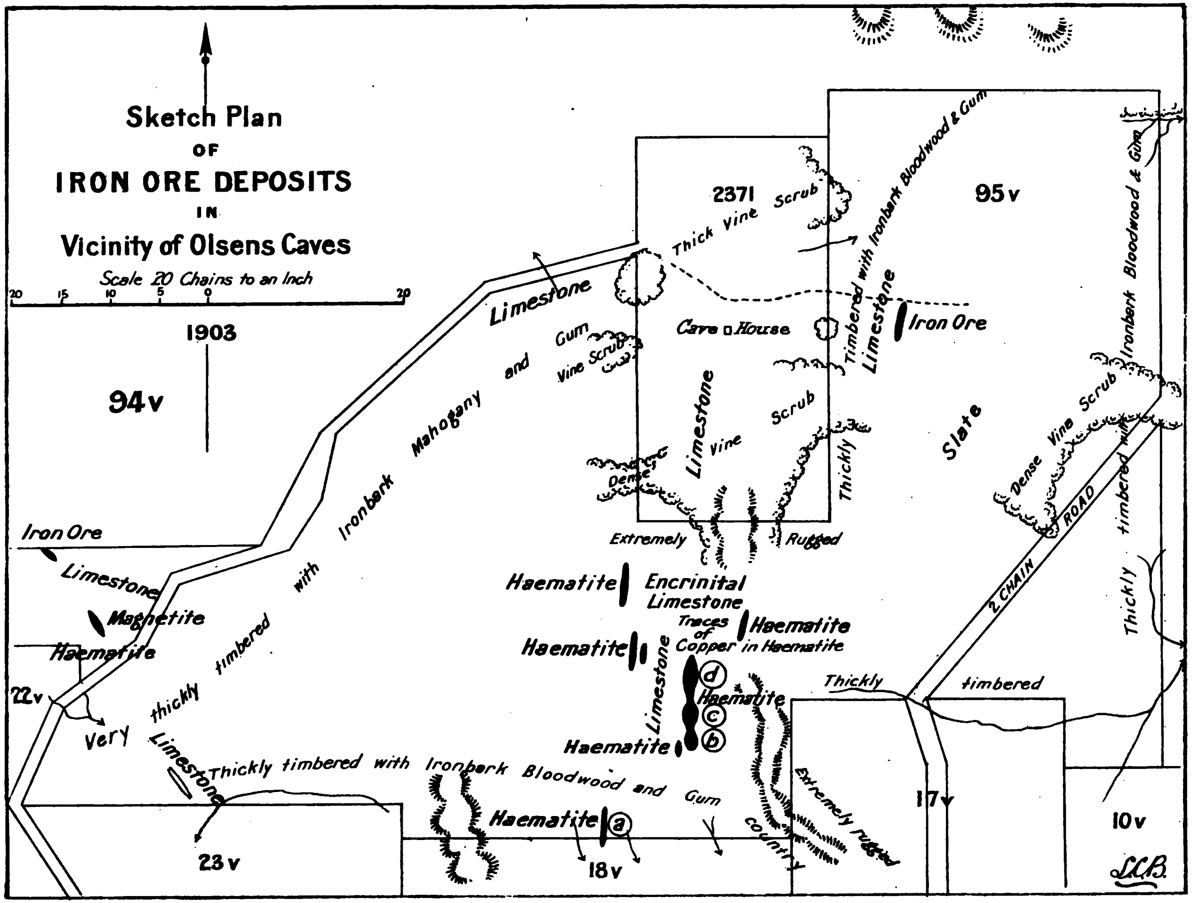
An estimate, necessarily rough, of the amount of ore above a depth of 100 feet is 7,000 tons.

Country.—The immediate country rock is greenish tuff slate and conglomerate, while further west is an ordinary clay slate. Blocks of marble occur on the beach but the bed itself is not visible. The country rock east of the deposit is veined with quartz in a similar manner to the ore; this quartz contains no cavities except where spangles and bunches of chlorite have weathered out from it. The country rock at a depth consists of impure limestone, and it is this chiefly that the iron ore has replaced. The less pure parts of this limestone have been altered into a greenish schist with disseminated crystals of calcite. The limestone, like the slates, is veined with crystalline white quartz containing bunches of chlorite, and in addition, radiating crystals of epidote. The formation of nodules of garnet can also be seen in places. Evidently there has been great regional metamorphism here, causing rearrangement and segregation of certain of the mineral constituents of the rocks, and the production of a schistose structure. My opinion is that the iron has been introduced subsequently, probably owing to a deep-seated intrusion, and precipitation has been caused by the limestones.

Workings.—This deposit was worked thirty years ago for copper. A shaft was then sunk on the seaward side of the Knob, in the hope that the amount of copper would increase with depth. The ground then lay abandoned till 1902, when it was again taken up and the shaft continued to a depth of 90 feet. It was then abandoned, probably because of the entrance of sea water, and an underlie shaft was sunk to 100 feet depth at the foot of the cliff, a chain from the first shaft. Both shafts are now full of water.

Conclusion.—This deposit is of importance in connection with that at Iron Island, its composition being in direct contrast to that at the latter place. It also points to the possibility of other deposits being found along this coast, and in fact another has been reported to exist on Long Island, in Broad Sound.

GEOLOGICAL SURVEY OF QUEENSLAND PLAN 4



Sketch Plan
OF
IRON ORE DEPOSITS
IN
Vicinity of Olsens Caves

Scale 20 Chains to an Inch

1903

III.—OLSEN'S CAVES.

(*a*) Portion 95v, Fitzroy.

Locality.—The main outcrops of iron ore in the vicinity of Olsen's Caves are on portion 95v, Fitzroy, 14 miles north-north-west of Rockhampton, and 5½ miles north-east of the nearest point of the Fitzroy River, which is there navigable for small boats. The road to the river has a down grade all the way.

Extent.—There are five outcrops from one to five chains in length and from two feet to two chains across, formed of boulders up to 10 feet in diameter. The main bodies lie on north and south lines, between portions 2371 and 18v. Owing to the thick grass at the time of my visit it was difficult to determine the extent of the deposits, but it is believed that the areas shown have not been exaggerated. (*See* Plan 4.)

Taking the depth of the deposits as equal to one-half the length, and only considering the three main ones shown on the plan (marked b, c, and d), which are two, two, and four chains long and two, one, and one-third chain wide, the amount of ore here is over one-quarter of a million tons.

Ore.—The ore consists of massive hæmatite and magnetite (specific gravity 4.8), with scarcely any visible impurity, except a little quartz in cracks far apart. A sample from the eastern line of outcrops (that marked b, c, d) assays (Mount Morgan):—

Iron	67 per cent.
Phosphorus	trace

Another from the western line yields (Mount Morgan):—

Iron	73 per cent.
Phosphorus	nil.

(This result is slightly higher than that necessary for pure magnetite.)

The ore is thus specially suited for the Acid-Bessemer process and of value for mixing with phosphoric ores, such as that on Iron Island, to render them low enough in phosphorus to be treated by the same process.

Geology.—That the ore here replaces limestone is proved by specimens showing the partial replacement, and besides where the ore can be seen in contact with limestone veins, and branches of the former pass into the latter. Nothing more definite can be said as to the origin of the deposits. They may be contact deposits of the Christiania type, as their position on the edge of the limestone indicates; but so little could be seen owing to the grass that this cannot be affirmed. No contact minerals were found there. The country rocks consist of slates and limestones, but as no fossils have been found in them their age is unknown. Devonian strata occur some miles to the south (at Raglan), and may be connected with them.

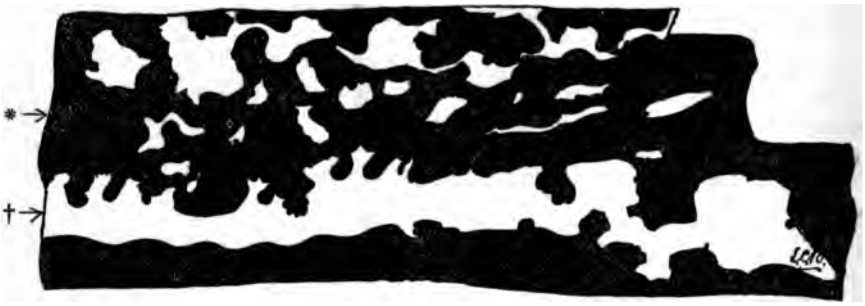
(*b*) Portion 22v, Fitzroy.

Locality.—Crown land, north-east of portion 22v, Fitzroy, three-quarters of a mile west of the above described deposits.

Extent.—The outcrop was followed in a north-westerly direction for two chains, its width varying from five feet to five yards. Another small outcrop is said to occur 10 chains to the north-west.

Ore.—The ore, which occurs on the western side of a bed of white limestone, consists chiefly of magnetite (specific gravity, 4.86), very impure as a whole, much of it being intergrown with garnet rock. A sketch (Fig. 1) of a specimen of this is given below—it probably represents slate or impure limestone partly replaced by magnetite.

Fig. 1.



* MAGNETITE. † GARNET.

IV.—KABRA.

Locality.—Kabra is a junction on the Central Railway, 11 miles south-west from Rockhampton and the Fitzroy River. Ore has been worked on portion 973, Gracemere, about a mile north-west of the station, and other small deposits are found capping a ridge running south-east through portion 146v, Gracemere. (*See* Plan 5.)

Geology.—In this locality the iron ore occurs in patches of highly-altered sedimentary rocks, the remnants of a former continuous covering over the syenitic granite, which extends from here southwards to Moonmera. Besides the iron ore, actinolite and epidote have been developed in the sedimentaries. Extensive beds of limestone lie to the north of the area being considered; they are slightly garnetiferous in most places, and the only fossils not obliterated are crinoid joints. The deposits are of the Christiania contact type, and therefore only to be expected in the calcareous sedimentaries near the intrusive granite.

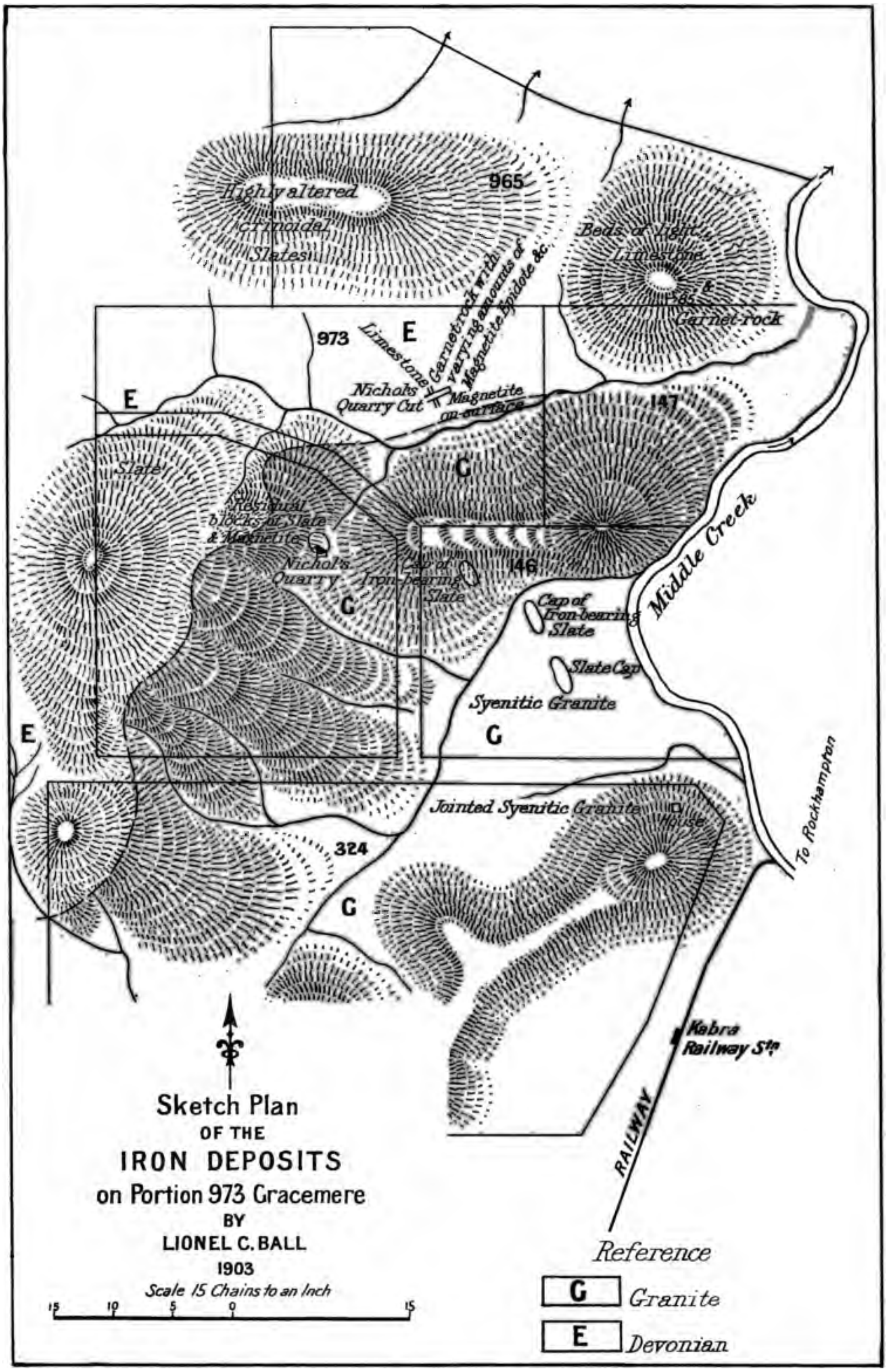
Ore.—The ore consists of massive magnetite of specific gravity 4.75, the analysis of a specimen of which is (Mount Morgan):—

Water	... ...	0·17
Silica	... ...	2·85
Alumina	... ...	1·43
Iron	... ...	66·00
Manganese	... ...	—
Lime	... ...	6·61
Magnesia	... ...	trace
Phosphorus	... ...	trace
Titania	... ...	—

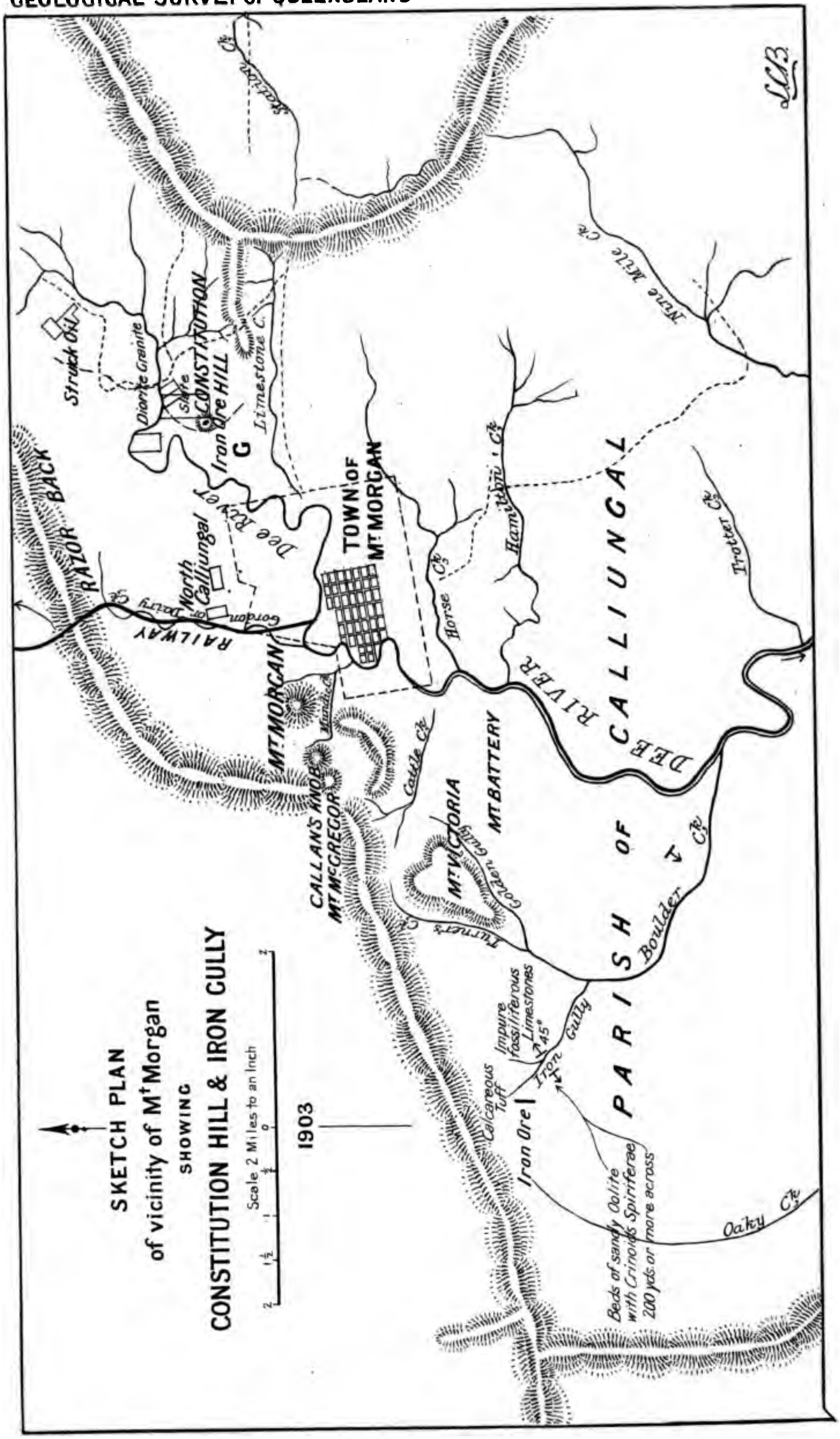
This shows the ore to be quite equal to the Scandinavian product. Were there any large quantity available it would be of value for mixing with the Iron Island ore.

Amount.—In the lower quarry is a patch of ore eight feet in greatest thickness, but its length is less than a chain. There are probably a number of small lenses here which could not be worked to any extent profitably. Though there is no large body of ore here much magnetite is distributed through the slates, but of course, quite unavailable.

GEOLOGICAL SURVEY OF QUEENSLAND PLAN 5


965
Highly altered Crinoidal Slates
Beds of light Limestone & Garnet-rock
585
973
E
Limestone
Garnet-rock with varying amounts of Magnetite Epidote &c.
Nichols Quarry Cut
Magnetite on surface
147
E
Slate
G
Residual blocks of Slate & Magnetite
Nichols Quarry
Cap of Iron-bearing Slate
146
Middle Creek
Cap of Iron-bearing Slate
Slate Cap
G
Syenitic Granite
G
E
Jointed Syenitic Granite
House
324
G
To Rockhampton
Kabra Railway Stn
RAILWAY
Scale 15 Chains to an Inch
15
10
5
0
15
Reference
G Granite
E Devonian

Sketch Plan
OF THE
IRON DEPOSITS
on Portion 973 Gracemere
BY
LIONEL C. BALL
1903



SKETCH PLAN
of vicinity of M^{t} Morgan
SHOWING
CONSTITUTION HILL & IRON GULLY

Scale 2 Miles to an Inch

1903

The only output thus far has been 250 tons sent as flux to Mount Chalmers.

Workings.—Nicholl's Quarry on the body above referred to is ten feet in diameter and six feet deep. Besides it there are only a few trenches.

V.—MOUNT MORGAN.

(*a*) CONSTITUTION HILL.

Locality.—Constitution Hill is three miles north-east of the Mount Morgan terminus, on the eastern side of the Dee River. Between the Dee and the Rockhampton Railway Line the country presents considerable obstacles to transportation, so that the ore would have to be taken down the river to the terminus in case of it ever being worked. (*See* Plan 6.)

Extent.—Boulders and fragments of ore cover a belt with an average width of six feet from near the hilltop (where 15 feet wide) to the bottom, some 200 feet below on the south; the ore gradually gets more siliceous towards the south, there being in the lower part probably only one to three feet of pure ore, and ten feet of siliceous ore and ferruginous quartzite. To the north the ore remains pure and increases in thickness, probably to ten feet, but after two chains it either cuts out or "pinches." There may be several other parallel bodies of ore. Taking the length as five chains, the depth as one-half that, and the thickness as six feet, there will be approximately 35,600 tons of ore here.

The long grass clothing the slopes at the time of my visit rendered it difficult to determine, even approximately, the extent of the deposit; trenching would, in any case, be necessary before the exact size could be decided.

Ore.—The greater part of the ore on the south is magnetite of specific gravity 4.53, that on the north is hæmatite, the former being, as a rule, more siliceous than the latter. Samples of the less siliceous material over an average width of six feet were assayed (at Mount Morgan) for the following results:—

	North end.	South end.
Water	0·46	0·30
Silica	4·00	2·30
Alumina	2 02	1·55
Lime	9·20	2·80
Magnesia	6·14	0·85
Phosphorus	trace	0 08
Iron	55·80	62·40

The ores are thus specially pure, though that from the south end shows a rather high percentage of phosphorus—that is, for the Acid-Bessemer process, which is the more likely to be used.

Workings.—Several small potholes have been opened on the outcrop, but there are no workings worthy of the name. Owing to the large quantity of interlaminated siliceous rock the ore would be difficult to work on a large scale.

Geology.—The country rock is altered slate with a north and south strike, and the strike of the deposit is the same. The occurrence on the eastern side of the ore body of intergrown magnetite and quartz—partly replaced rock, comparable to the taconite of the American geologists—is interesting. Granite outcrops within a quarter of a mile to the south of the outcrops, and its intrusion into the sedimentaries was most likely the cause of the formation of the ore bodies.

(*b*) IRON GULLY.

Locality.—Iron Gully, one of the head branches of Boulder Creek, is six miles west-south-west of the Mount Morgan Railway terminus, in very rough country.

Extent.—There are a number of bunches of ore between the ridgetop on the south-west and the bottom of the gully 200 feet beneath. On the top of the ridge only traces of ore are to be seen, but a chain down the hill is an area ten yards in diameter, covered with fragments of ore. Half a chain below this, fragments are again in evidence, an area extending down the hill for several (five) chains, gradually widening from one-half to three chains in width, but the ore at the same time becoming gradually very impure, parts, in fact, being simply ferruginous slate. Without extensive trenching it would not be possible to determine the amount of marketable ore here, and therefore no attempt is made to calculate the quantity.

Ore.—The ore is bright and solid magnetite, with small cavities filled with powdery limonite and hæmatite. An analysis of a sample from the larger outcrop results (Mount Morgan):—

Water	0·66
Silica	8·33
Alumina	3·04
Iron	62·65
Manganese	—
Lime	2·20
Magnesia	—
Phosphorus	0·167
Titania	—

The phosphorus is thus abnormally high, and would effectually prevent the exploitation of the deposit for the supply of Acid-Bessemer furnaces. A trace of copper carbonate is occasionally to be seen, but there is not sufficient to affect the stone's value as an ore of iron. Strong stains of manganese dioxide occur in the northern part of the deposit.

No work has been done here.

Geology.—The outcrop runs north and south, the country being altered sedimentaries of Permo-Carboniferous age. Oolitic limestones occur both east and north of the ore deposit, one bed striking north-west across its northern end. West of the magnetite area is an outcrop of impure brownish limonite, with specks of hæmatite; this appears to be a partly replaced slate.

VI.—ALMA CREEK.

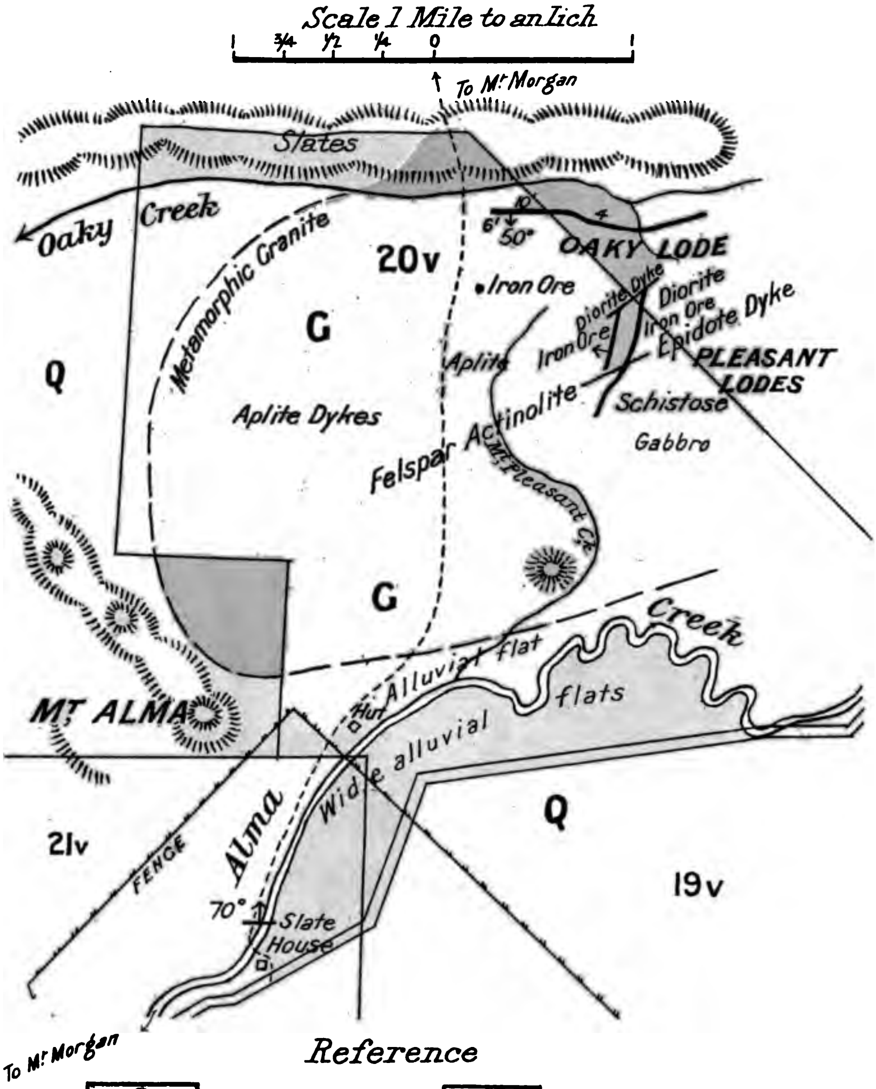
Locality.—Both the outcrops seen pass from 20v, Ulogie, on to the Crown land on the north-east. (*See* Plan 7.) They lie 15 miles south-south-east of the terminus of the Mount Morgan Railway. Portion 20v itself is held under grazing lease, with 20 years' tenure from 1899.

PLAN
OF
IRON LODES
ON
Portion 20v Bunerba
PORT CURTIS DISTRICT

BY

LIONEL C. BALL

1903



Reference

G *Gabbro*

Q Quartzites Slates &c. of undetermined age

Plate 4 a.

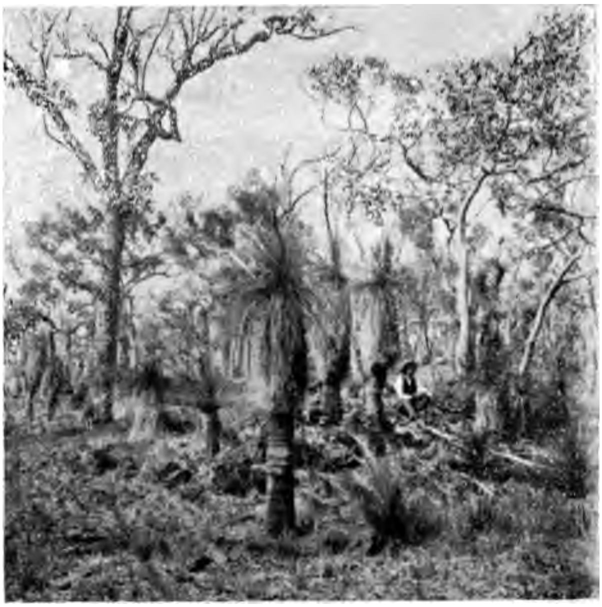


Photo., L.C.B.

Outcrop of Iron Ore, Western Extremity of Oaky Lode, Alma Creek.

Plate 4 b.

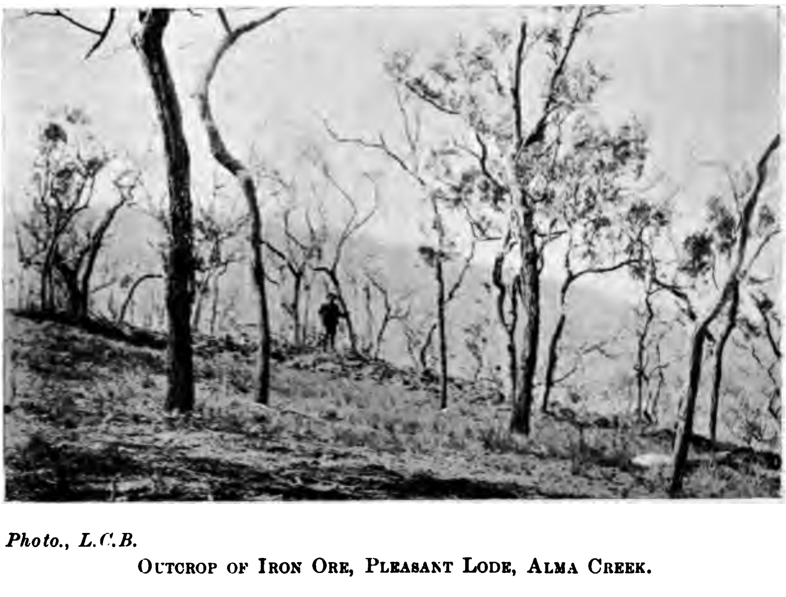


Photo., L.C.B.

Outcrop of Iron Ore, Pleasant Lode, Alma Creek.

The first (Oaky lode), half a mile from the northern boundary of portion 20v, is within the watershed of Oaky Creek, a tributary of Alma Creek, which is an affluent of the Dee River. The second (Pleasant lode) is in the catchment area of Pleasant Creek, another tributary of Alma Creek, three-quarters of a mile south-east of the first.

It is most probable that there are numerous other lodes in this district. Specimens were shown me of splendid ore from the country between Alma and Centre Creeks, about three miles south-east of the above lodes. Another has been seen by Captain Richard, south of Piebald Mountain. Further, the road from Piebald to Alma passes about midway (*i.e.*, about four miles east of the Dee River) between those places, over a stretch of very ferruginous soil, in which a few fragments of jasperoid are to be found. This may be a large soft ore deposit, similar to those of Lake Superior, and is well worth prospecting by shallow pits.

The present outlet for this district is up the valley of the Dee to Mount Morgan, the terminus of a railway from Rockhampton. There would seem to be no engineering difficulties in constructing a railway to connect with that terminus.

It is to be hoped that a thorough survey may be made of this district when time permits.

Extent.—

Oaky Lode.—At the western extremity (*see* Plate 4A) the lode is six feet wide, but towards the east it quickly widens to 12 feet and runs so for five chains, when it contracts to six feet again for a chain, and then increases to ten feet, and continues so for four chains; it then pinches to two feet, but gradually increases again to the boundary fence of portion 20v, a few chains further on. Outside the fence the lode varies between two and four feet in thickness for ten chains, then pinches to a foot, but again gradually increases to an average of three feet (exceptionally ten feet), and runs so for three-quarters of a mile. The difference in level between the highest and lowest portions of the outcrop is about 300 feet, and there does not appear to be a single break in the lode.

Taking into consideration only the part of the lode within 20v, there will be (assuming the lode to continue without change in depth) 118,000 tons of ore within 100 feet of the surface.

Pleasant Lode.—This lode (*see* Plate 4B) was traced for a distance of a little over half a mile, over ridges 100 feet high, and proved to have an average width of six feet. It suddenly "pinches" just outside portion 20v. Within the portion the outcrop—a mound of fragments—varies from 10 to 15 feet across, and rises two to four feet above the general surface. The amount of ore between the surface and 100 feet depth may be calculated with the above dimensions (presuming that it persists in depth, and taking the specific gravity as 5), to be a quarter of a million tons.

A parallel lode ten chains west of the above was followed for rather less than half a mile south from the boundary fence. Its average width is less than two feet.

Ore.—The ore in all the outcrops consists of very finely granular titaniferous hæmatite and magnetite, but it is magnetic only in places, and never strongly. Through most of it there are white laths. Its specific gravity is 4.3.

The following analyses were made at Mount Morgan of representative samples collected by me:—

—.	Oakey.	Pleasant (Crown Land.)	Pleasant (20v.)	Parallel (Pleasant.
Water	0.56	0·45	0·54	0 24
Silica	10·40	12·80	5·55	14·35
Alumina	1·70	9·81	12 52	12·33
Iron	56·27	55·42	55·10	48·30
Manganese	—	—	—	—
Lime	2·85	3·95	2·65	3·92
Magnesia	Not detd.	Trace	—	—
Phosphorus	0·025	0·114	Trace	Trace
Titania	Present	—	Present	—

That both the main lodes contain titania was proved, though the amount was not estimated. Titania amounting to two per cent. is usually looked upon as sufficient to condemn an ore owing to the formation of an infusible cyano-nitride in the furnace. At the same time at certain furnaces in the United States similar amounts have been successfully slagged off.

The silica, in all except the Pleasant ore, is also rather high though not excessive, owing to the presence of alumina and lime. The phosphorus in that from the Pleasant lode on Crown land is far too high for the acid process, but the others are specially low in that element.

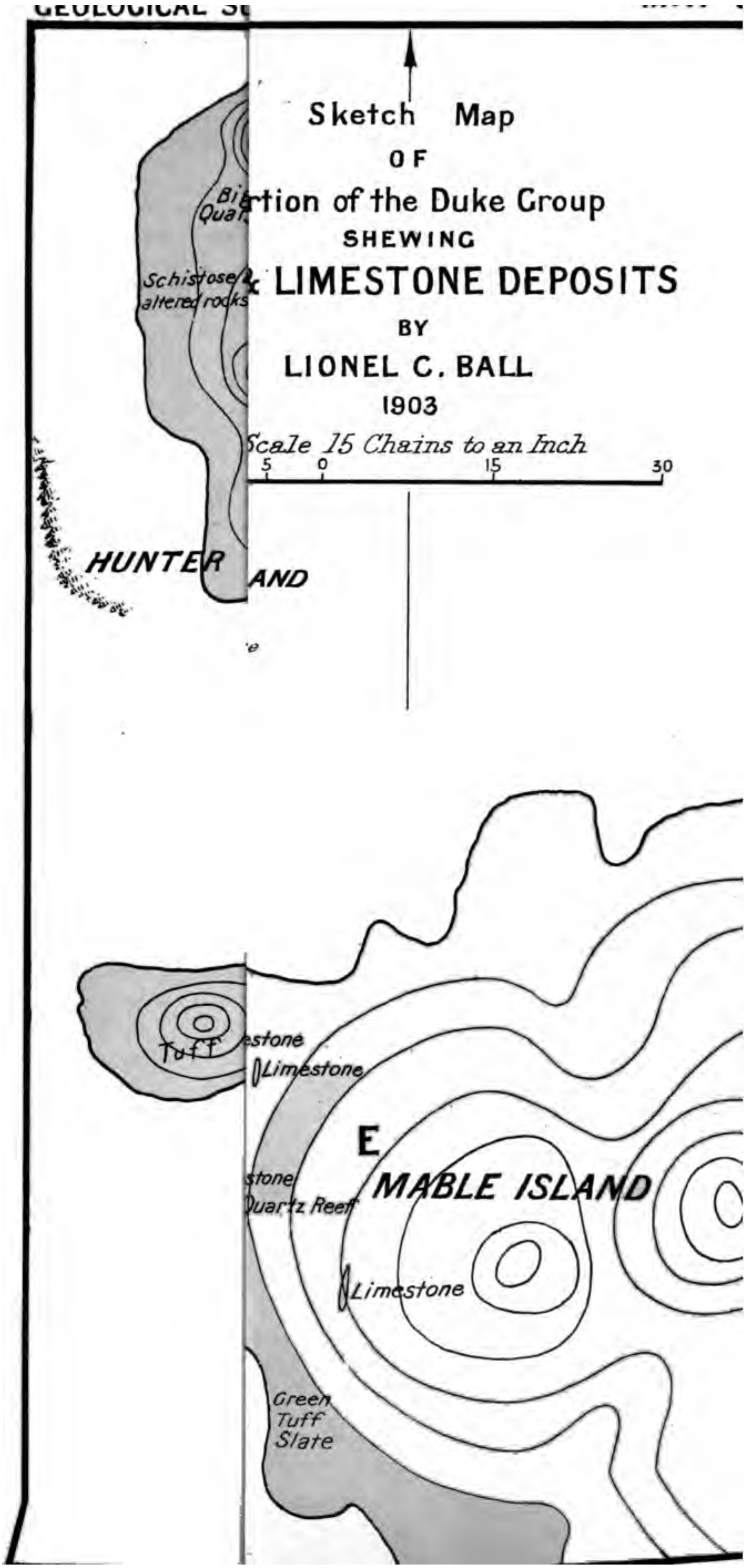
Workings.—The only workings at the present time are two or three prospecting potholes two to four feet deep, the result of leasing 160 acres on the Oaky lode in November, 1902. The surface portions might be worked by open cut methods, but owing to the comparatively small width of the ore bodies underground, mining would have to be undertaken at a slight depth.

Geology.—The lodes occur in gabbro, which in their vicinity at least is slightly schistose. Near the northern extremity of the Pleasant lode the country is less schistose, but shows orientation of the felspar, and its physical appearance is very similar to that of the ore. A section of the rock proves it to consist of plagioclase and augite, with interspaces filled with magnetite, which mineral often completely surrounds crystals of augite. Both felspar and augite are quite undecomposed, the only sign of alteration being slight stains round the magnetite.

At other places on the eastern side of the lode magnetite is greatly developed, apparently having replaced other minerals than quartz and felspar. Near the eastern portion of Oaky lode hornblende is present, and the rock there would be almost a diorite but for the magnetite filling the interspaces.

The gabbro area is about two miles in diameter (in a north and south direction), passing into metamorphic granite (altered sediments?) on the north-west, and bounded by slates on the south-west. The extent towards the east is not known. There is no reason to doubt that the gabbro is intrusive in the slates, though there was no opportunity to search for dykes in the latter.

Several fine-grained diorite dykes are to be seen in the vicinity of the Pleasant lodes, one cutting across the northern end and one running between the lodes. There is in addition a cross vein consisting chiefly of crystalline felspar, but containing in places considerable actinolite, epidote, and ilmenite. This has every appearance of an aplite, and is presumably pneumatolitic in origin. Several other outcrops of similar rock were seen at various points in the gabbro area. There is therefore a possibility of the lodes also being pneumatolitic in origin.



Sketch Map
OF
rtion of the Duke Group
SHEWING
& LIMESTONE DEPOSITS
BY
LIONEL C. BALL
1903

Scale 15 Chains to an Inch
5 0 15 30

As shown on the plan, the lodes have a length of from half to one and a-half miles. The two southern ones are parallel, and strike nearly north-north-east and south-south-west (while dipping west), the other running at right angles to them, and dipping 50 degrees to the south. This proves that the deposits were not originally bedded lodes.

The ore is generally metallic and black in colour, but its powder is brownish-red. Throughout the ore are scattered small white oriented laths, which, when hollow, have the creamy gummy appearance of lencoxene, the decomposition product of ilmenite. They are, however, most likely included felspar crystals. The ore at one of the potholes is seen to be in layers, probably an effect of weathering. The ore bodies are sharply marked off from the country rock, and the first thought is that they are very basic dykes, but it is not conceivable that such material could have remained fluid in so small a fissure. The ore does not appear to have replaced the country, so that the only explanation remaining is that segregation occurred before complete solidification of the magma took place. This segregation may have been partly or wholly pneumatolitic, the elements being dissolved and transported in an aqueous gaseous solution.

B—*Limestones.*

I.—THE DUKE GROUP.

This group, forming part of the Northumberland Islands, and consisting of Marble (two square miles), Mortar (ten acres), Iron (ten acres), Hunter (half a square mile), Tynemouth (half a square mile), Bamborough (three-quarters of a square mile), and several small unnamed islands, lies in longitude 150 degrees 14 minutes East and latitude 21 degrees 58 minutes South. (*See* Locality Map 8.) The islands are about half-way between Rockhampton and Mackay, and eight miles north-east of the nearest point on the mainland.

Eucalyptus occurs in the valleys on Marble Island, but on the others the only trees are a few pines. The rounded grass-covered hills are quite a feature of the islands.

The country rocks on all seen (*i.e.*, all except Bamborough) are greenish schistose tuff slate, clay slate, and limestone of Devonian (?) age. Dr. Jack, as the result of a hurried visit,* mapped part of Hunter and Marble Islands as granite. It is believed that the rock on Hunter Island is simply a highly-altered sedimentary, but absolute proof is given in the case of Marble Island by interstratified crinoidal limestone in the area there shown as granite.

(*a*) MORTAR ISLAND.

Locality.—Mortar Island is separated from the north-western promontory of Marble Island, the largest of the Duke Group, by a channel 15 chains wide. (*See* Plate 6.)

The Admiralty charts show seven fathom soundings in Lola Montes Pass to the west of Mortar Island, but it is possible that ships of moderate tonnage could berth almost alongside the quarry—at least with a floating jetty. The water on the northern side of the island appears deep enough to float a large vessel under similar circumstances. The extremely high tides, and the consequently strong currents experienced among the islands, may cause a little inconvenience, but should not prevent the loading of the stone, for where strongest—*i.e.*, in Lola Montes Pass—they were successfully negotiated when the Marble Island quarries were worked.

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* **Rep. on Geological Features of Mackay District. By R. L. Jack, 1887. Brisb. By auth.:** G.S.Q.P., No. 39.

Extent.—It is about 15 chains in greatest diameter, and with the exceptions of the eastern end and a narrow diorite dyke running north and south through the centre, the whole is limestone. The height is about 100 feet. (*See* Plan 9.)

Geology.—The channel between the two islands may have been caused by trough faulting, throwing Mortar Island to the east; but even then the thin-bedded slates on the east of Mortar Island are not evident on Marble Island. Indistinct corals and crinoids were observed in the impure limestones occurring with the slates on the east, and lamellibranchs (sections), were seen in the limestone quarried on the south.

Limestone.—On the eastern side of the island is a bed, eight to ten yards wide, of limestone, "grained" white, blue, and yellow, a material specially suitable for ornamental work.

The central bed of marble is five chains across, and on the north the stone is practically without a trace of impurity; it weathers into sharp knife edges, and most of it is quite uncovered by soil or even a lichen growth. (*See* Plate 5.) This would seem to be almost fit for statuary purposes, though perhaps scarcely saccharoidal enough. It is fissured on the surface, but at a shallow depth it would be possible to obtain large blocks.

The western bed is not quite as pure as the central. The limestone on the south side of the island has a slight bluish tinge, and along cracks has been stained by percolating waters.

The stone quarried ran 98 per cent. calcium carbonate (on the authority of Mr. Campbell, who did the work). A sample taken by me from the whole island ran (Government Analyst):—

$Ca\,CO_3$	97·5
$Mg\,CO_3$	trace
$Si\,O_2$ and insoluble ...	1·88
Fe_2O_3 and Al_2O_3	0·74
	100·12

The marble thus far taken from the quarry has been bluish or creamy, but much of it, especially the mottled-blue and white, is well adapted for ornamental work, and takes a fine polish. A few specimens secured in the quarry have been polished, and are now on exhibition in the Survey Museum. A small quantity of crystalline-banded aragonite occurs, filling fissures in the quarry, and there should be a sufficient local demand for this material for ornamental work to make it worth while setting it aside in working.

Workings.—The only work done was on the southern side, where there is a quarry from which several hundred tons have been shipped. (*See* Plate 6.)

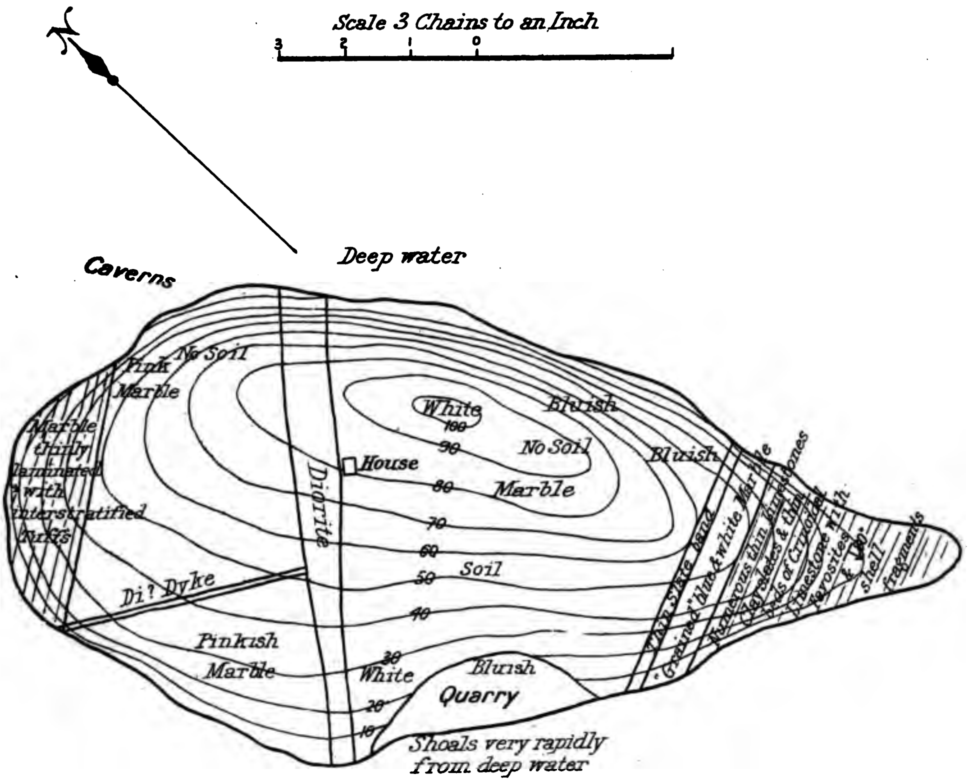
(*b*) MARBLE ISLAND.

Locality.—Marble Island is the most south-easterly and the largest of the Duke Group. (*See* Map 8.)

Extent.—A number of small outcrops are to be seen in the western portion, but the main one is on the extreme north-western headland. It extends north and south for about ten chains, rising some 50 feet abruptly from deep water.

Limestone.—The limestone as a whole is not quite as pure as that on Mortar Island. It varies from pink on the north to mottled-blue towards the south, while on the extreme south is a rock resembling a conglomerate, and formed of boulders of marble. The last was originally either an impure limestone, in which segregation of the calcium carbonate has taken place, or

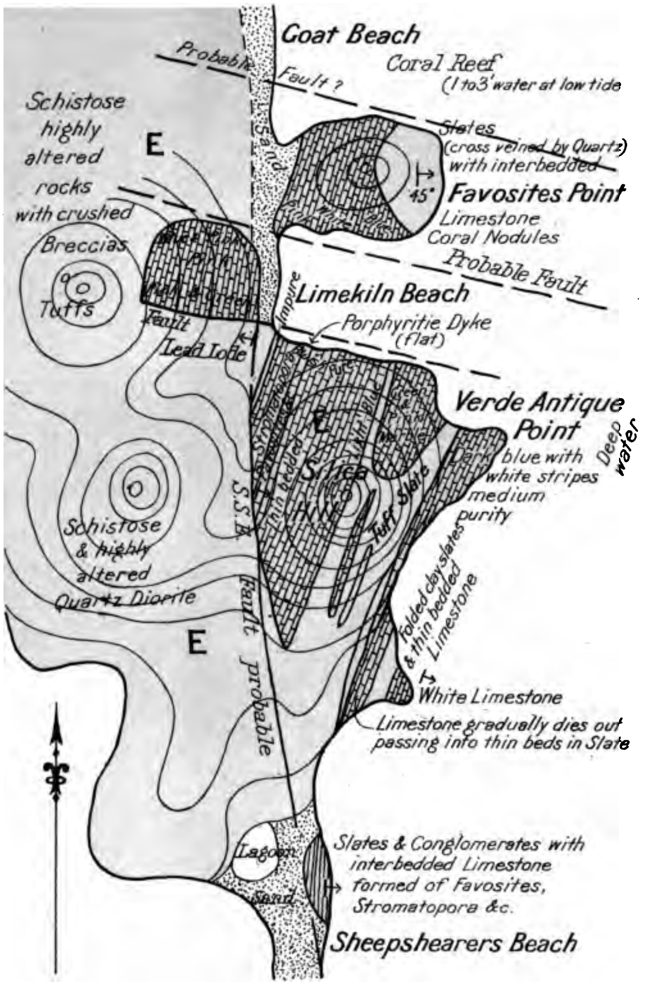
Sketch Plan
OF
MORTAR ISLAND
SHEWING
Extent of Marble
BY
LIONEL C. BALL
1903


Scale 3 Chains to an Inch
3
2
1
0
N
Deep water
Caverns
No Soil
Pink Marble
Marble thinly laminated with interstratified Tuffs
White
100
Bluish
90
No Soil
House
80
Marble
Bluish
Diorite
70
60
Soil
50
Di? Dyke
40
Pinkish Marble
30
White
Bluish
Quarry
20
10
Shoals very rapidly from deep water
Thin Slate band
Greenish blue & white Marble
Numerous thin limestones
Clayslates & thin beds of Crinoidal limestone with Favosites & Dio.
shell fragments

Sketch Plan
OF
Limesione Outcrops
ON
HUNTER ISLAND
BY
LIONEL C. BALL
1903

Scale 10 Chains to an Inch

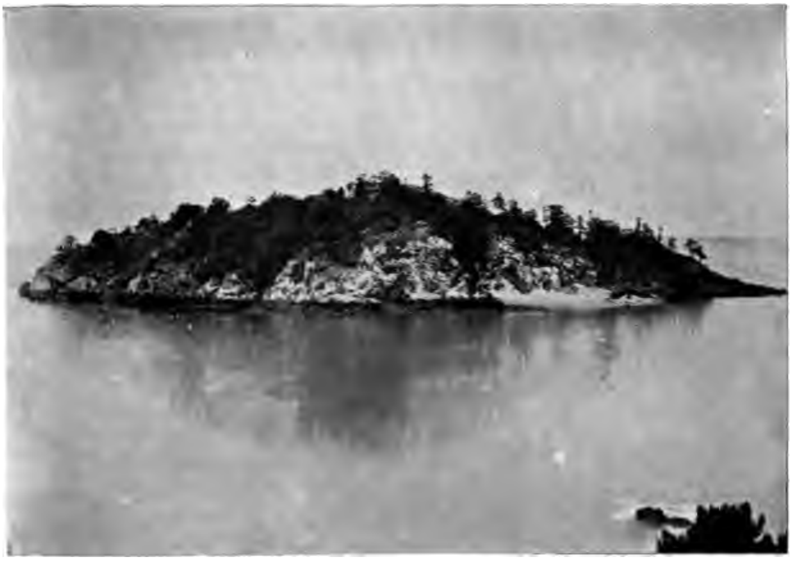
10 7½ 5 2½ 0 10


Coat Beach
Coral Reef
(1 to 3' water at low tide
Probable Fault?
Slates (cross veined by Quartz) with interbedded
Sand
45°
Favosites Point
Limestone Coral Nodules
Probable Fault
Schistose highly altered rocks with crushed Breccias
Tuffs
E
Fault
Lead Lode
Impure
Limekiln Beach
Porphyritic Dyke (flat)
Verde Antique Point
Dark blue with white stripes medium purity
Deep water
E
Silica Hill
Stromatopora
Thin bedded
Tuff Slate
S.S.E. Fault probable
Schistose & highly altered Quartz Diorite
E
folded clay slates & thin bedded Limestone
White Limestone
Limestone gradually dies out passing into thin beds in Slate
Lagoon
Sand
Slates & Conglomerates with interbedded Limestone formed of Favosites, Stromatopora &c.
Sheepshearers Beach

Reference

E *Devonian* ▨ *Limestone*

Plate 5 a.



Photo, L.C.B.

MORTAR ISLAND, VIEWED FROM MARBLE ISLAND.
(*Showing height of tides and Limestone Quarry.*)

Plate 5 b.

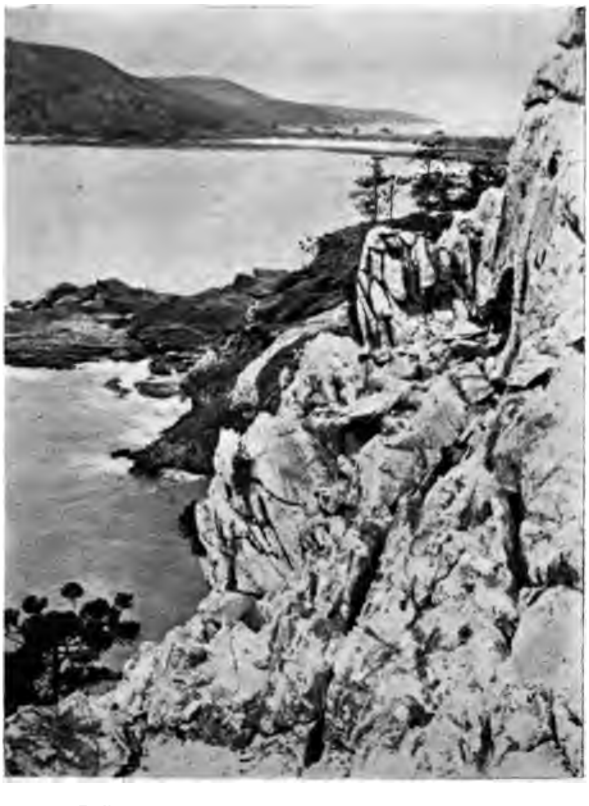


Photo., L.C.B.

MARBLE CLIFFS, NORTH-EASTERN SIDE OF MORTAR ISLAND.
(***Marble Island** in the distance.*)

Plate 6 a.

Photo., L.C.B.

LIMESTONE QUARRY ON SOUTHERN SIDE OF MORTAR ISLAND.

Plate 6 b.

Photo., L C.B.

MORTAR ISLAND AND MARBLE ISLAND QUARRY.

(*Viewed from Hunter Island.*)

Plate 7.

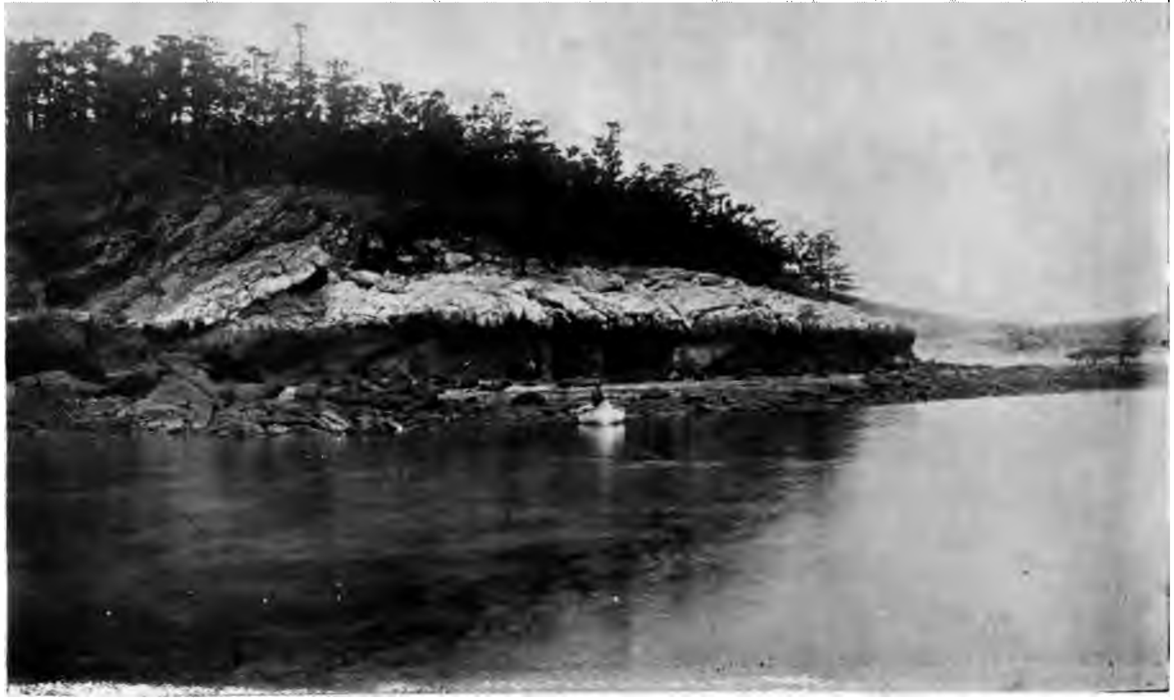
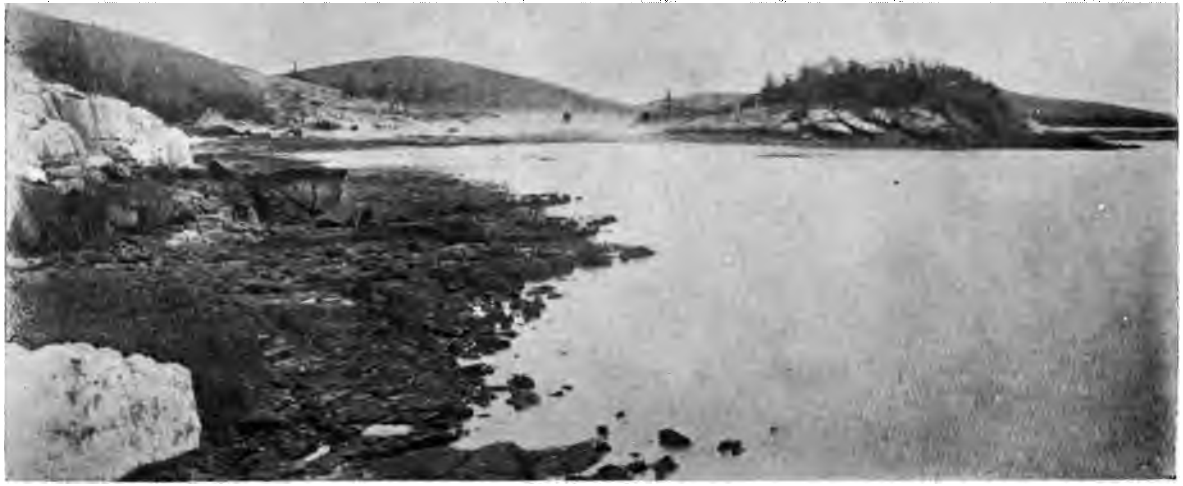


Photo., L.C.B.

MARBLE, FAVOSITES POINT, HUNTER ISLAND.

(Viewed from the North at low tide.)

Plate 8.



Photo, *L.C.B.*

LIMEKILN BEACH AND FAVOSITES POINT, HUNTER ISLAND.
(*Viewed from Verde Antique Point at low tide.*)

else, and more probably, a shale with nodular masses of coral, &c. The intersticial cementing material is of different colours, but typically red. The rock is quite unfit for lime-making, but would make a splendid building stone. Similar rock to this occurs on the Calliope River in the Gladstone district.

Workings.—Several thousand tons of stone have been blasted from the face of the cliff, and as many as six barges of 500 tons burden have loaded here at one time, pontoons being employed as floating jetties. (*See* Plate 6.)

Many thousand tons of stone suitable for lime-making still remain.

(c) HUNTER ISLAND.

Locality.—Hunter Island is the second largest of the Duke Group, and lies a quarter of a mile west of Marble Island.

The limestones, of which there are five distinct areas (*see* Map 10) occur near the centre of the eastern side, every area with a water frontage. The most northerly forms the greater part of Favosites Point (i.); the second lies inland from Limekiln Beach (ii.); and the third, fourth, and fifth form Silica Hill (iii.).

(*i.*) *Geology.*—The outer portion of Favosites Point consists of slates, with interbedded limestones dipping 45 degrees to the east. The slate are, as elsewhere on the islands, traversed by cross veinlets of quartz (segregated from the country), which, however, never enter the limestone. Besides the thin beds of limestone there are bands of isolated masses of corals, chiefly favosites, but also cyathophylloids (?). These beds are similar to those on the eastern side of Mortar Island.

Limestone.—Below, and to the west of the slates, are limestones—first impure yellowish, gradually passing into dirty blue (for two chains), then white (for three chains), and at the base of the Point pink (for ten yards). The bed has probably a total thickness, normally to the stratification, of four chains. The width of the point is about eight chains, and the height 50 feet.

The water round the point is shoal at low tide, safe anchorage being at least 15 chains out. (*See* Plates 7 and 8.) Were it desired to exploit this limestone it would be most convenient to load the limestone into punts and tranship at the anchorage, the construction of a pier to deep water being out of the question.

(ii.) The Limekiln Beach outcrop may be a faulted portion of the Favosites Point basal beds. It is five chains in diameter.

Limestone.—The northern portion is mottled-blue and pink, the central is chiefly pink, while the southern is pink and green with veining of glanconitic material. The pink and pink and blue portions would be of value for lime-making, while the pink and green should make a most beautiful building and ornamental stone.

This would have to be shipped in a similar manner to that from Favosites Point.

Geology.—The outcrop is cut off on the south by a fault striking south-south-east—*i.e.*, towards the southern side of Mortar Island—and near it both marble and slate are very much contorted. Running off from the fault, about 20 feet above the beach, is a vein of galena and gossan, six to 12 inches thick, striking north and south, and dipping west, while the country dips east. A few fragments were secured and assayed (Government Analyst):—

Gold	trace
Silver	2 oz. 18 dwt. 22 gr. per ton
Lead	8·3 per cent.

The vein is most certainly worth prospecting.

(iii.) *Extent.*—Silica Hill rises 250 feet above the sea. The whole of its western and part of the eastern and northern sides are composed of limestone.

Geology.—The basal beds on the west have thin interlaminated slate seams for a distance of four chains from Limekiln Beach. They contain abundant favosites and some stromatopora, often converted into silica.

Favosites is, in fact, abundant everywhere, stromatopora occurring as nodules, chiefly in the thin-bedded impurer portions, and in the slates.

They appear to have been cut off on the west by a north-north-west striking fault, and towards the south they and the limestones above them gradually fade into calcareous shales.

Limestone.—East of the basal beds is three chains of pure blue limestone, followed by four chains of pink marble, with green glanconitic "graining" relieved by pink crinoids. The last naturally makes a beautiful ornamental stone.

Much of the limestone on Silica Hill is rather impure, as shown by the silica replacing the corals. Certain of the clayey beds might give good results in the manufacture of hydraulic lime. Some of the limestone is dark-blue in colour, and is "grained" with white stripes, a combination much sought after by ornamental stonemasons.

Limestone cliffs also overlook the sea on the eastern side, where the water at Verde Antique Point is several fathoms deep, so that it might be possible to construct a wharf there for the loading from the whole of Hunter Island. It would, of course, be necessary to take into account the great rise and fall of the tides here and the consequent rip, but they seem to have been overcome by the use of floating jetties.

Thin-bedded and nodular limestones occur in the slates and conglomerates on Sheepshearers' Beach, but are of no account economically though most interesting geologically because of their contained fossils.

2. RAGLAN.

Considerable bodies of limestone are known to exist on Raglan Creek, which empties into the estuary of the Fitzroy; they have, however, not yet been inspected.

3. FITZROY RIVER.

Large areas of limestone of very good quality lie north of the Fitzroy River, four and 20 miles above Rockhampton. They are the source of most of the lime now being used in the Central District.

C—Manganese Ore Deposits.

Several manganese deposits in the district between Rockhampton and Emu Park have been worked from time to time to supply Mount Morgan. They have not yet been inspected.

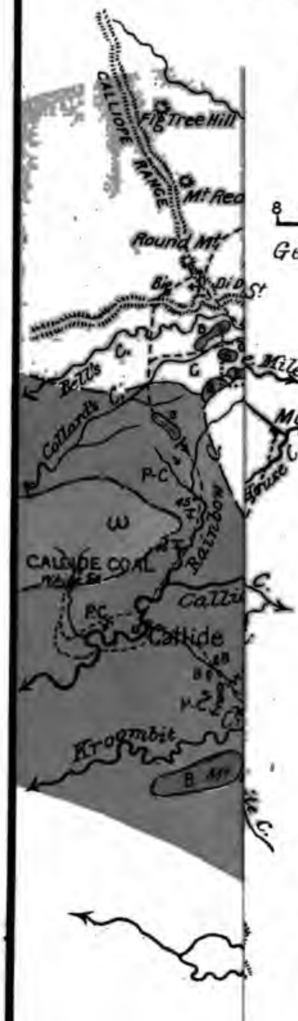
1. COOROOMAN.

The main workings are at Coorooman. Prior to January, 1903, 123 tons of manganese ore had been received at the Mount Morgan works, running between 60 and 70 per cent. manganese dioxide.

Locality Map
OF
IRON DEPOSITS
IN THE
Gladstone District
BY
LIONEL C. BALL
1902

Scale 8 Miles to an Inch
8 7 6 5 4 3 2 1 0 8

Geological Boundaries Approximate



Reference

P-C *Permo-Carboniferous*
E *Devonian*
G *Granite*
B *Basalt*
ω *Ipswich Beds*
J *Burrum Beds*
D? *Desert Sandstone*
✠ Iron Ore

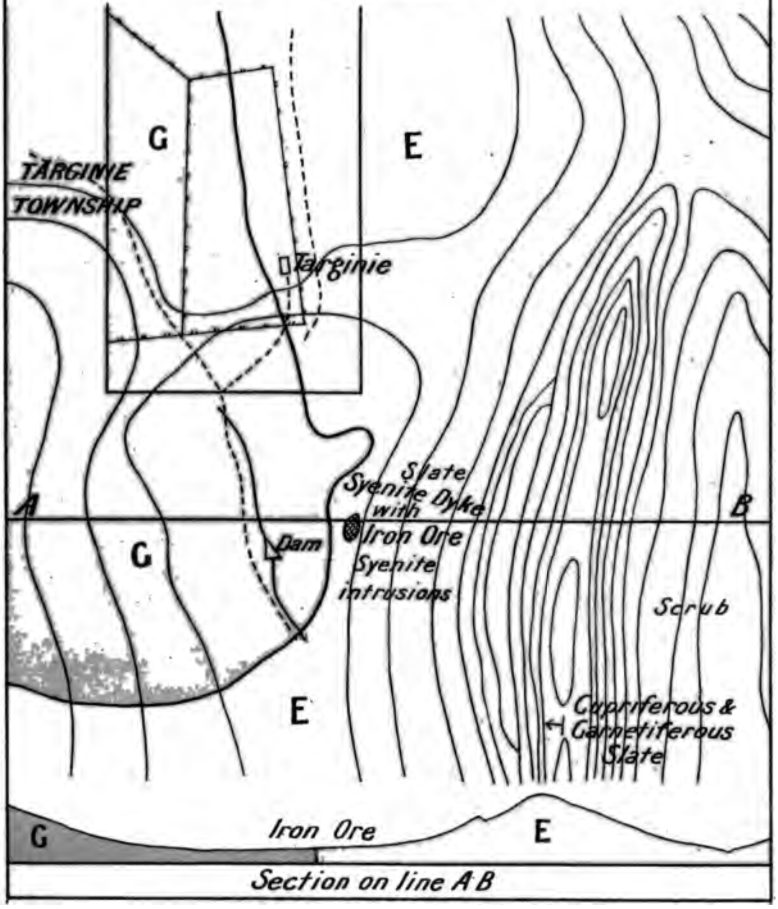
GEOLOGICAL SURVEY OF QUEENSLAND **PLAN 12**

Geological Sketch Map
OF
country in the neighbourhood of
TARGINIE
BY
LIONEL C. BALL
1902

Scale 30 Chains to an Inch

Reference

E	*Devonian*
G	*Granite*



II.—GLADSTONE DISTRICT.

A—Iron Ore Deposits.

The iron ore deposits in the Gladstone district are scattered over an area 60 miles in diameter. (*See* Locality Map 11.)

The only deposits of any considerable size are at Glassford and Many Peaks, but the outcrops at several other points, notably those on the Boyne River, are well worth testing. The places visited are described below in order from north to south.

1. TARGINIE.

Locality.—Targinie head station lies 9 miles west of Gladstone, a little over 3 miles north-north-west of the railway station of same name, and 2½ miles from the shore of Port Curtis. The head of navigable water for small boats on Boat Creek is 4 miles distant by road.

The outcrop of iron ore is half a mile south-south-east of the head station, and has been included in a lease of ten acres adjoining portion 402, Targinie (in which tho station stands), on the south-eastern corner. (*See* Plan 12.)

Extent.—Blocks of the ore up to six or seven feet in diameter cover an area of about 50 feet square, a single block being also found 150 yards south-south-west of the main outcrop. The deposit appears to be an isolated one. Its greatest thickness is ten feet on the north, from which it tapers to the south. A landslip just east of the deposit is thought by the lessee to cover a further extension to the north, but it is not likely.

Ore.—The ore is massive hæmatite and magnetite, crystalline in parts. It sometimes contains epidote and garnet. An assay of ore made for the lessee gave 94 per cent. of ferric oxide, equivalet to 65.8 per cent. metallic iron. A sample collected by me from the whole of the outcrop yields (Government Analyst):—

Iron ...	... 64·9 per cent.
Silica ...	... 5·2 „
Phosphorus	... nil.
Sulphur ...	... trace.

The amount of ore outcropping is less than 200 tons. There is nothing to indicate that there is a large deposit here; it is probably lenticular in form, and in that case may not contain more than 1,000 tons altogether.

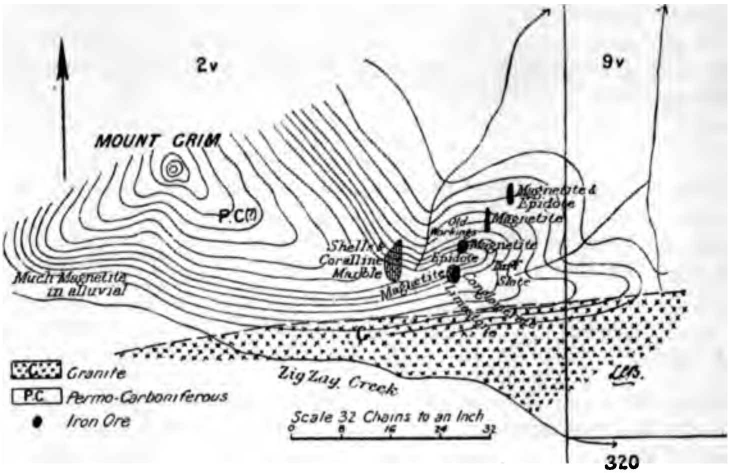
Geology.—The country rock is garnetiferous epidote-bearing slate (Permo-Carboniferous?), stained in places with copper carbonates and manganese oxides. Intrusive granite is found a few hundred yards west and north of the ore deposit.

This is a contact deposit of the Christiania type, the metallic minerals having been given off from the granite, and condensed in the slates, probably on a calcareous band. The absence of limestones hereabouts is rather against any probability of considerable bodies of ore being found. Two or three shallow pot-holes and trenches have been opened beside the blocks. No prospecting for iron has been done in the district.

2. MOUNT GRIM.

Locality.—Mount Grim is in the centre of Farmer's portion 2v, Alma, 3½ miles west-south-west of Mount Alma Station, and 31 miles west of Gladstone. (_See_ Map 11.) It is four miles from the Gladstone-Banana road, along which it is understood the Callide railway is to run.

Fig. 2.



Extent.—The ground was held some years ago for copper-mining, and two old fallen-in tunnels are now to be seen on an outcrop composed of blocks of magnetite up to six feet in diameter. There is nothing to show the thickness of the deposit, though it is probably less than 10 feet. West of the iron ore is garnetiferous calcite, with thin lenses of magnetite, said to carry 5 dwts. of gold per ton, patches of quartz crystals and stains of copper carbonates. (_See_ Fig. 2.)

On the southern side of the ridge on which the above occurs are huge blocks of magnetite (up to six feet in diameter) over a width of 20 feet for a distance of two chains. There may be several distinct lenses.

Geology.—The country rock consists of highly altered tuff slates, &c., which, from the nature of the outcrops, it is presumed strike north and south. Granite occurs within quarter of a mile to the south.

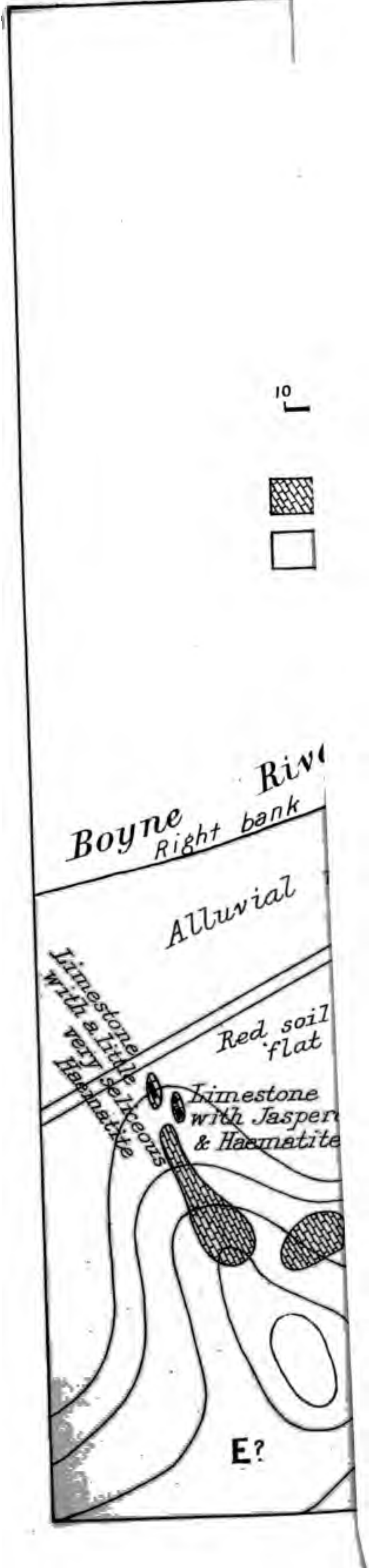
Ten chains to the west of the iron ores is a large outcrop of marble, with fragments of shells and corals (lithostrotion ?) preserved in silica. Their age is probably Permo-Carboniferous.

About a mile west of this magnetite boulders are very plentiful below the soil of an alluvial flat opening into Zigzag Creek, worked years ago for gold. No lode has been discovered.

Two miles south-east of Mount Alma Station are some old copper workings on garnet rock and limestone. These rocks might prove of value for fluxes.

The Callide coal leases are about 25 miles south-west from the above deposits, so that this country is worth prospecting.

GEOLOGICAL SURV


10
Boyne Riv
Right bank
Alluvial
Limestone with a little very siliceous Haematite
Red soil flat
Limestone with Jasper & Haematite
E?

3. BOYNE RIVER.

(*a*) PORTION 406, RIVERSTON.

Locality.—Portion 406, Riverston, is 16 miles south of Gladstone, and on the northern side of New Zealand Gully. It is 6½ miles south-south-west of Annandale Railway Station, with which it is connected by road. (*See* Map 16.)

Extent.—The thickness of the lode may be anything up to three feet. Boulders of ore are plentiful in the bed of New Zealand Creek, on the line of strike, 20 chains from the house, but no outcrop is to be found there. A sample from these boulders assays (Government Analyst):—

Iron, 59·3 per cent.

Near the house the outcropping portions are rather siliceous, and towards the creek changes into quartzite, with veins of iron oxide.

Geology.—The iron lode strikes north-north-west, passing within two chains to the east of the old house, in the south-west corner of the paddock. The dip appears to be 45 degrees to east-north-east. The country west of the lode is porphyrite interbedded in Devonian (?) slates, which on the line of lode appears in places to be partly replaced by iron ore. East of the lode are altered epidote-bearing slates, with patches of marble and interbedded andesites. North-east of Chance Gully, in which the lode occurs, is serpentinous schist, while coarse-grained diorite forms brown soil north of the gully.

As no work has been done on the deposit it is difficult to determine its origin. It is probable that it is a contact deposit, the ores having been derived from intrusive granite or diorite at a short distance below the present surface. The diorite, a short distance to the north, and the occurrence of numerous contact deposits a few miles south of this, gives colour to the hypothesis.

Mr. Rands has referred to this occurrence.*

(*b*) PORTION 22V, PEMBERTON.

Locality.—This forfeited selection is on the south bank of the Boyne River, 19 miles south of Gladstone and two miles east-north-east of the Marblestone Crossing (Gladstone-Glassford road). (*See* Map 6.)

Extent.—Ten chains west of Middle Creek, and the same distance from the river (*see* Plan 13) is a U-shaped outcrop of Devonian limestone 15 chains across.

At the northern extremity of the western arm hæmatite occurs as irregular strings and bunches with jasperoid in limestone.

The iron ore on the eastern arm forms five separate outcrops within a distance of ten chains. That marked (1) on the plan consists of a few tons of loose blocks up to a foot in diameter, covering an area of two yards north and south by eight yards east and west—*i.e.*, with its length across the limestone. This was referred to by Mr. Rands in a former Report† as a dyke. The next (4) lies about ten yards west of (1); it is a yard wide and two yards long, and consist of fragments chiefly of magnetite up to two feet in diameter. It lies parallel to the limestone, and there is probably limestone under it (hidden by soil). Outcrop (2) is in limestone, interlaminated with and replacing it at the southern end. Blocks of ore cover an area five yards wide east and west and six yards long north and south. The ore is the most siliceous in the locality, and most of it would be useless. The main outcrop is (3), covering an area a chain wide east and west and three-quarters of a chain long north and south, but it probably extends a chain further beneath the soil to the north-east. The most northern outcrop (5) is only a small one, with its length on a north-north-west line.

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* *Loc. cit.*, G.S.Q.P., No. 21.

† On the Goldfields of Raglan, Calliope, Milton (Norton), and Cania, in the Port Curtis District; and in the Mineral Districts in the Burnett District. W.H.R. By Auth: Brisb., 1885. G.S.Q.P., No. 21.

A sample taken from the whole of the outcrops yields (Government Analyst):—

Iron ...	... 64·9
Silica ...	... 6·74
Phosphorus	... nil.
Sulphur ...	... trace.

Ore.—The ores are hæmatite and magnetite in about equal quantities, gradually grading into one another, the magnetite being chiefly on the western side of the outcrops. A little limonite is found in cavities and occasional pieces of quartz, but the ore as a whole is free from visible impurities.

General considerations point to the iron having been given off from the granite, and precipitated by the action of the limestone, which has been partly replaced.

(*c*) PORTION 10V, PEMBERTON.

Locality.—Portion 10v is on the eastern side of the Calliope-Bompa road, three and a-half miles south of the Marblestone Crossing. (*See* Map 16.)

Extent.—The first outcrop is a quarter of a mile south of the northern boundary of the portion, about ten chains east of the road, and 100 yards north of a small creek coming down from the Many Peaks Range. It consists of blocks of magnetite up to four feet in length, covering an area ten feet wide and a chain in length (north-west and south-east). The ore is chiefly magnetite, often crystalline, but in places altered into hæmatite, and even into cellular limonite. There is just the faintest trace of green copper carbonate in one place, not enough to affect its value as an iron ore. A rough sample assays (Government Analyst):—

Iron, 67·4 per cent.

Isolated blocks also occur for a chain further to the south, and on the hill to the north, probably resulting from other smaller lenticular patches.

Geology.—The country is greenish chalcedonic Devonian slate, highly altered by the intrusion of the Many Peaks granite mass to the east, which probably caused the formation of the deposit. Limestone outcrops in large quantities on the road, some of it being pure white and saccharoidal.

Scattered fragments of magnetite are found on the Eastern Boyne road, one and a-half miles from the Gladstone-Milton road, just within the catchment area of Oaky Creek. The country is epidote slate. This is the most southern of the deposits, on the edge of the Many Peaks granite, seen.

Owing to the abundance of limestone in the slates along the boundary of the granite, it is very likely that there are numerous other iron ore deposits in the strip between portion 406, Riverston, and 10v Pemberton—in portions 3v, 26v, 22v, 5v, 6v, 7v, 8v, 9v, 10v, and 11v.

The iron ore may be expected to increase in depth till the granite is reached, above which it will be most abundant, but in which it will not be found.

Should the Glassford railway be carried down the Boyne to Marblestone as has been proposed, this country would be well worth prospecting, there being every possibility of large ore deposits occurring beneath the small outcrops.

4. DEGALGIL.

Old gold workings on Degalgil Creek, just above the entrance of Koolkooroom Creek, 40 miles south of Gladstone. (*See* Map 11.) Very siliceous limonite on the surface, of no value as iron ore but possibly copper-bearing at a depth. Slate country with intrusive diorite.

5. KROOMBIT.

(*a*) FIVE-MILE (OR CALLIDE) COPPER MINES.

Locality.—Ten leases for copper-mining were taken up some years ago, four miles east-south-east of Kroombit Station, and 52 miles south-south-west of Gladstone. They are all drained by branches of Allen's Creek. (*See* Locality Map 11.)

Old Workings.—The older and most eastern workings are on Five-mile Creek, two miles above the Cania road. Here a double shaft was sunk on Devonian (?) slates replaced by hæmatite and crystalline black copper oxide. The strata bend in the shaft, on the west striking about south-west and on the east striking east and west (locally), with a steep dip to the south. The copper appears to follow a vertical fissure striking south-west, the ore bulging out to three feet in places, but often thinning to six inches. A tunnel on creek level has been driven into hillside for 100 feet, branching at the end, without striking an ore body, though there are stains throughout. In the tunnel the country is very hard actinolite slate.

Blocks of both hæmatite and limestone are found in the creek, at the mines, and for some distance below. Hæmatite and a little manganese ore are seen on the track to the mine, and siliceous hæmatite ocurs at the houses just south-west of Frampton's furnace area.

Newer Workings.—The newer workings are within half a mile west of the older, and higher up the hill. Taken up under application-register number 62. The ore is siliceous hæmatite, with a little copper carbonate, which on the surface is too siliceous as an iron ore, though it is likely to improve with depth, and might then be hand-picked. Numerous trenches have been opened on this siliceous ironstone, which is about a chain in diameter. The main shaft is inaccessible, but has been sunk to sulphides. Magnetite occurs scattered over a considerable area on the hill beyond the workings.

Geology.—The country rock is tuffaceous slate, forming a red soil. The lode is probably partly sulphide and partly oxide (replacing slate), and the silica will probably decrease with depth. The country would be well worth prospecting for iron, all work done thus far having been for copper.

The fact that these deposits are only 18 miles in a direct line south-east from the Callide coal mines, makes them all the more valuable. It is true that ranges have to be crossed on the routes to Gladstone, but they present no great engineering difficulties.

(*b*) CANIA ROAD.

A bed of beauxite occurs on the Cania road, three and a-half miles south of Kroombit Station. Its thickness is about six feet, and it can be seen to extend for two chains. Below it is a pink porcellanous limestone (secondary), above is a cap of olivine basalt. Search would probably prove similar laterite beds to those in New England, New South Wales. The ore is suitable for the manufacture of iron or aluminium, or for a flux.

6. MANY PEAKS.

Locality.—The Many Peaks copper leases are on portion 4v, Bompa, 46 miles south-south-east of Gladstone, on the southern side of the Glassford road, in the bend between the Boyne River and Glassford Creek. (*See* Map 14.) They are 19 miles south-west of Miriam Vale Railway Station, and beside the proposed Glassford railway.

Extent.—The lodes are probably on a zone or zones of crushed andesite, in slate, rendered schistose and pervious to solutions. The metallic minerals occur in bunches on a bent line running through the centre of the leases, there being nine distinct outcrops of gossany ore, apparently separated by barren country, within a distance of a mile south of Deception Creek, along which the Glassford road runs.

At the No. 1 workings the outcrop is soft powdery iron ore with copper carbonates. The main portion of the lode, averaging ten feet in width, alters within 100 feet depth to sulphide, but there are large bunches of hæmatite, one mass on the No. 1 adit near the main shaft, 110 feet below the surface, being ten feet across.

Ore.—A certain small amount of magnetite and hæmatite might be separated in working these deposits for copper. The iron sulphide residue from leaching the copper ore may in the future be used for the manufacture of sulphuric acid, in which case the iron oxide remaining would be valuable as an iron ore. Neill's processes, or Van Arsdale's, might be expected to give good results here in the extraction of the copper, with simultaneous production of high-grade iron oxide.

Mr. Rands has reported on these leases.*

With regard to fluxes, limestone occurs in large quantities in a number of places along the Calliope and Boyne Rivers, and also at Kroombit, Cania, Glassford, and Many Peaks, and with garnet rock at Glassford and Diglum Creek.

The nearest coalfield is the Callide, on the western side of the area examined. Prospecting has been carried on here, proving the existence of several thick seams of coal, probably suitable for coking. The trial survey for a railroad to connect the field with Gladstone has been completed. In case of work not being commenced on this field, coal or coke could be brought to Gladstone by water from the Burrum or Ipswich or Central fields.

7. GLASSFORD.

Locality.—Glassford lies 60 miles south of Gladstone, on the left-hand head branch of Glassford Creek. The battery site is 33½ miles south-west of Miriam Vale Railway Station, and is 950 feet above sea-level. (*See* Map 11.)

Historical and general matter will be found in Mr. Rands' annual report for 1899.

Geology.—The accompanying map (15) shows that the Glassford ores form contact deposits of the Christiania type. Granite has intruded the slates, and

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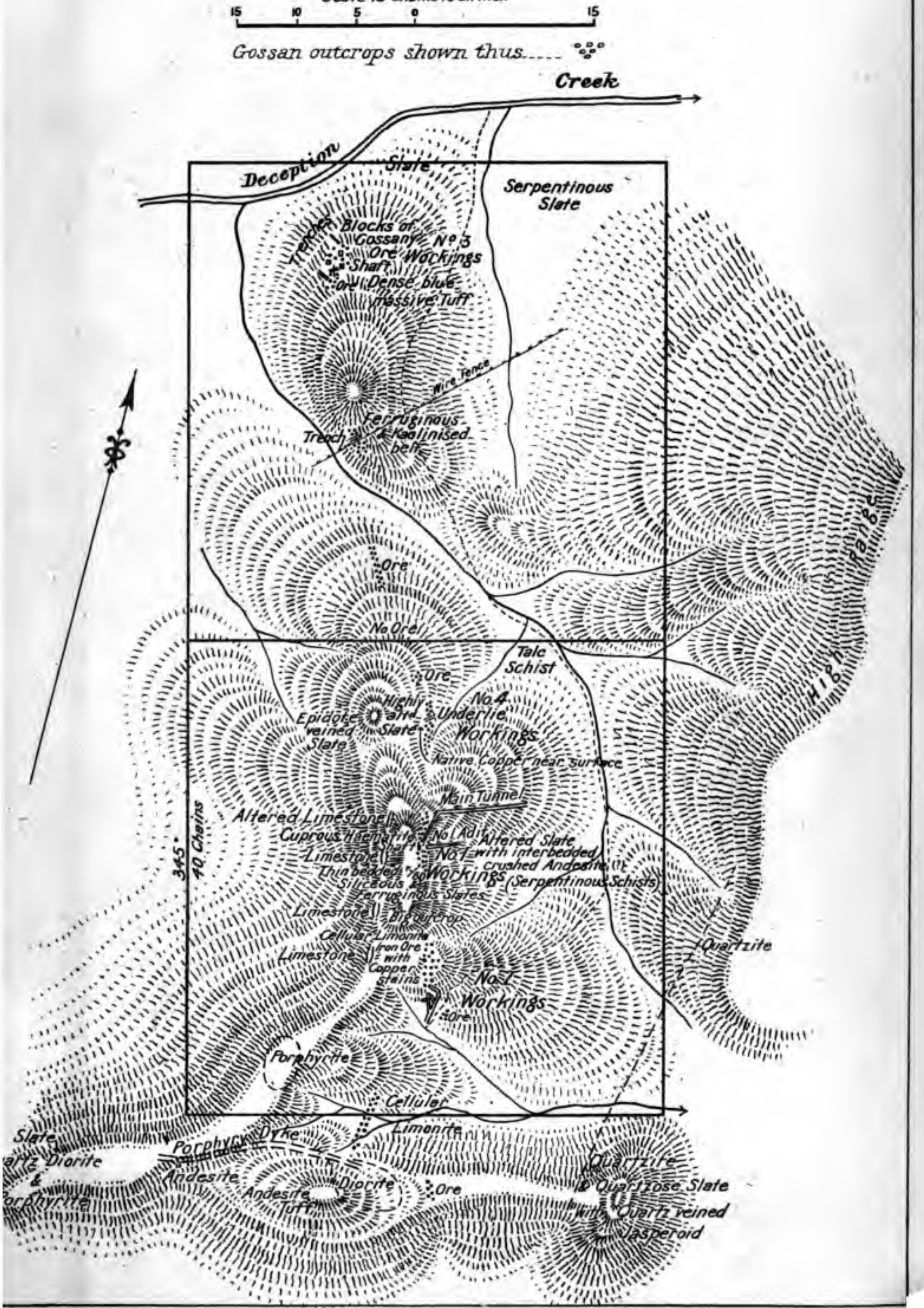
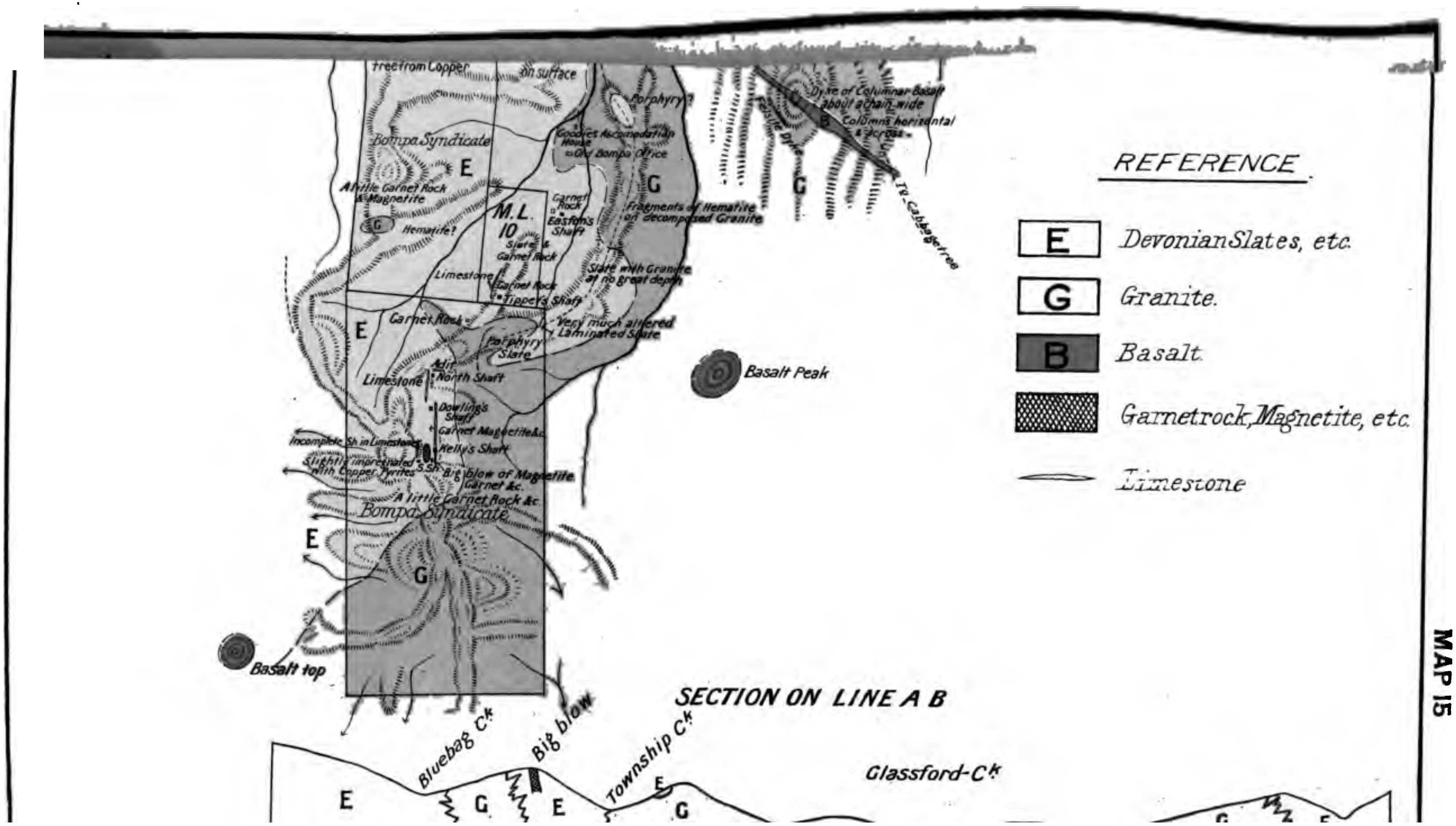
* *See* No. 150 of the Geol. Survey Publications.

Rough Sketch Plan
OF
MANY PEAKS LEASES
(based on plan at the Mine)
BY
LIONEL C. BALL
1902

Scale 15 Chains to an Inch



MAP 15


REFERENCE
E Devonian Slates, etc.
G Granite.
B Basalt.
Garnetrock, Magnetite, etc.
Limestone
Free from Copper on surface
Bompa Syndicate
A little Garnet Rock & Magnetite
Hematite?
M.L. 10
Slate & Garnet Rock
Garnet Rock
Easton's Shaft
Limestone
Tipper's Shaft
Porphyry?
Goodes Accomodation House
Old Bompa Office
Fragments of Hematite on decomposed Granite
Slate with Granite at no great depth
Very much altered Laminated Slate
Garnet Rock
Porphyry Slate
Adit
North Shaft
Limestone
Dowling's Shaft
Garnet Magnetite &c.
Kelly's Shaft
Incomplete Sh in Limestone
Slightly impregnated with Copper Pyrites
S Sh
Big blow of Magnetite Garnet &c.
A little Garnet Rock &c.
Bompa Syndicate
Dyke of Columnar Basalt about a chain wide
Columns horizontal & across
Felsite Dyke
To Cabbagetree
Basalt Peak
Basalt top
SECTION ON LINE A B
Bluebag Ck
Big blow
Township Ck
Glassford-Ck
E
G
B

in cooling has given off various metallic minerals (including oxides of iron and copper sulphides) which have been precipitated in the slates in the vicinity of limestones. Garnet rock is the chief accompanying mineral.

Extent.—The line of junction of slates and granites runs through the town, with a general north and south direction from half a mile north of it to one and a-half miles south, and on this portion most of the ore deposits are found. Outcrops of garnet rock, usually associated with ore in this district, are to be seen as far as one and a-half miles north of the town. The two main outcrops are the Blue Bag, on the Reward Claim, a quarter of a mile west of the town, and Kelly's, on No. 5 Lease, one and a-half miles south of the town. The former has a length of over a quarter of a mile, and the latter about one-eighth of a mile.

Mr. Rands, in the above report, describes the workings, which were all accessible at the time of his visit. The quotations below are from this report:—"The main deposit can be traced right through and beyond these properties (the four leases held by the Bompa Syndicate), and there are in addition other smaller ore bodies on which but little work has yet been done to test their value. The main portion of the deposit is a true lode, but in parts the country rock is also highly impregnated with copper. The country consists of quartzites, slates, and greywackes, with intrusive masses of granite. A white crystalline limestone often occurs alongside the lode." As my plan shows, there are numerous detached deposits, none of which continue through all the properties.

"Lease No. 5.—South Shaft . . . is 114 feet in depth . . . entirely in syenitic granite. At the bottom a drive was put in east for 35 feet, which for the last ten feet passed through a body of ore consisting of specular iron ore, magnetite, calcite, and copper pyrites."

"Kelly's Shaft . . . is 107 feet in depth, . . . straight down to a depth of 94 feet, when it strikes the footwall and follows the westerly underlie . . . able to get down as far as the 70-feet level, where a westerly crosscut has been driven for a distance of 25 feet, all in lode material. The ore is chiefly of magnetite, with copper pyrites disseminated through it . . . there are . . . patches of calcite, and garnetiferous rock . . . also occurs." The outcrops of garnet rock and magnetite are ten feet wide.

There is a large outcrop of garnet rock and magnetite between the South and Kelly's Shafts.

"Dowling's Shaft.—The depth . . . was 151 feet, and down to 121 feet it was entirely in the limestone, which here outcrops on western side of the lode. In the last 30 feet the ore body has an underlie of four feet, and the bottom of the shaft is entirely in ore. . . . The ore consists of magnetite and garnetiferous rock, with copper pyrites through it . . ." Probably lenticular patches of magnetite in garnet rock as well as disseminations.

"Northern Shaft, . . . 110 feet in depth, . . . entirely in limestone. A crosscut was driven west for six feet in hard garnet rock, with splashes of copper pyrites through it. A crosscut has also been driven east-south-east for 49 feet, . . . the first 42 feet in limestone, and from that point there was a formation consisting chiefly of limestone and calcite carrying numerous garnets. . . . Patches of magnetite, and a fair amount of copper pyrites." Galena and blende are both present.

Easton's Shaft was begun on garnet and hæmatite-bearing slates forming a capping on granite.

A couple of lenticular patches of hæmatite and magnetite near the centre of the northern boundary of M. L. 6, about three feet wide and ten yards long.

" Kelly's Tunnel, on Kelly's Claim, north-west alongside lode, and then west across it for 12 feet. . . . Intrusion of granite at mouth of tunnel. First six feet of ore is magnetite with copper pyrites, the remainder garnet rock." The southern tunnel is ten chains from the northern. Opened in decomposed granite just under limestone. Ore contains much magnetite, and occurs under and in the limestone. There is some fine magnetite and hæmatite on the surface just south of this.

" Reward Claim.—The Blue Bag tunnel, 27 feet in length, has been driven into the lode in a north-west direction, all in lode. . . . The gangue carries a good deal of magnetite." In the creek are up to 20 feet of garnet rock, with patches of hæmatite and magnetite and stains of carbonates of copper on the surface, giving way to copper pyrites in a few inches.

The Blue Bag Shaft is 100 feet deep, with a steep underlie to west for 50 feet, and then vertical. In a rich bunch of ore lying on decomposed porphyritic granite and adjacent to the Blue Bag garnet rock. A few chains to the north is another shaft, 30 feet deep, with a drive for 30 yards to the south-west at the bottom, passing through cupriferous garnet rock. In the face is massive hæmatite.

" The (Blue Bag) lode in Glassford Creek consists on its east side of quartzite and garnet rock, with copper pyrites. Next to this there is five feet in width of magnetite, in which are large cavities filled with calcite. The magnetite contains copper pyrites throughout it. Then there is four feet of garnet rock with copper carbonates. The lode is certainly 25 feet wide." Ten feet width of ore rises 15 feet above the ground on the side of the creek, and consists in great part of magnetite, chiefly as bunches, with copper pyrites in garnet rock.

" Big Blow.—At northern boundary of the Reward Claim is the North Tunnel, driven about 100 feet in a westerly direction, through quarzites and hard garnet rock. At the face is hard garnet rock, with copper pyrites and large patches of magnetite."

The tunnel is driven under a very large copper-stained garnet blow. The garnet rock here does not look promising either for iron or copper.

Amount.—Taking the amount of magnetite in the Glassford ore as one-fifth of the whole, the total amount of ore within 200 feet of the surface on the leases now held will not exceed half a million tons.

Future.—The only possibility of the iron ore being worked is in connection with the copper and gold. Magnetic concentration would leave the copper and gold ore in an ideal condition for smelting, the magnetite in a pure state being obtained as a by-product.

It is proposed to construct a railway line either to Miriam Vale, *viâ* Many Peaks and Mount Jacob, a distance of 33¼ miles; or to Gladstone, following the mail road down the Boyne River, a distance of 80 miles.

8. CANIA.

(*See* Map 11.)

TOWNSHIP.

Locality.—Cania is 58 miles south-south-west of Gladstone, and the same distance north-west of Mount Perry. Miriam Vale, the nearest railway station, is 42 miles distant.

Extent.—Half a mile east of and above the township is a small deposit, about a chain in diameter, of cellular, rather siliceous, limonite. The iron ore probably replaces Permo-Carboniferous limestone, an outcrop of which occurs on the west, and it may pass into carbonate at a depth. This body alone is of no value, but it points to the possibility of there being others in the locality.

SPRING CREEK.

Locality.—The old Spring Creek Gold Diggings are ten miles north-east of Cania.

Extent.—There are several small outcrops of iron ore in this locality, the largest crossing the Cania-Monal road, about quarter of a mile west of the workings. This is about two feet wide, and in places consists of pure hæmatite with garnet rock, but as a whole would not be pure enough even if large enough to be worked. The country rock here is Devonian (?) slate and tuff, dipping 70 degrees to south-west.

There is at present no practicable outlet for ore from here, the Burnett Range being to the west—*i.e.*, towards the Callide Coal Field—and Dawes' Range to the east, towards Mount Perry. To within 25 miles of Mount Perry there is a gentle down-grade, but the country then becomes broken.

9. CABBAGE-TREE.

Locality.—Cabbage-tree lies 54 miles south of Gladstone, on the southern flanks of Dawes' Range. It is 40 miles north-north-west of Mount Perry. (*See* Map 11.) A few years ago several leases were taken up for copper-mining, but now the place is practically deserted.

Outcrops.—Impure hæmatite and limonite blows occur on Monument Hill, near some old trenches, and there are numerous iron-stained outcrops.

Blocks of hæmatite can be seen in the creek on the western side of Apple-tree Lease.

The largest hæmatite outcrop seen here is on the head branch of a small creek about half a mile south of the hotel. It strikes north-west, its greatest width is ten feet, and it runs for about a chain. The ore consists of hæmatite and limonite, and is nearly free from quartz.

B—Limestones.

1. CALLIOPE RIVER.

(*a*) CALLIOPE CROSSING.

In the bed of the Calliope River, between portion 1, West Stowe, and portion 66, East Stowe, a quarter of a mile below the crossing on the Gladstone-Rockhampton road, are several exposures of limestone, all within a radius of ten chains. (*See* Map 20.)

The main, most northern, outcrop is about 50 feet wide, 25 feet high and five chains long. It consists mostly of very pure light-grey marble, but much of it is beautifully coloured. It contains, as a whole, one per cent. of visible impurity (veinlets and coatings of iron oxides and clay). The limestone continues to the north, but is covered by the alluvial soil on the bank of the river. A nine-feet dyke of porphyrite (?) runs through the limestone, the three feet in centre being coarsely porphyritic, while the outsides are very fine-grained.

A few chains south of the above are several other outcrops, up to four chains in length. That near the centre of the river is 20 feet wide, and consists of a reddish limestone, traversed by very ferruginous veins, which should be of great value for building and monumental purposes.

Within half a chain of this, on the west, is another outcrop 20 feet wide, and the Marble Island in the river, six chains to the south, may be a continuation of this bed. The greater part is pure bluish stone, with cross-veins of white calcite, the couple of feet on each side being very ferruginous. The rock has the structure of a conglomerate but consists entirely of limestone. It tapers out to the north.

West of this, near the bank of the river, is a north and south zone, containing overlapping interbedded lenticular masses of limestone. This would probably be of use for a building-stone, but is too impure for lime-making. The limestone has the appearance both of replacing the slates (on the sides) and of having segregated from them, in which case the clayey impurities remaining have encrusted the lumps of limestone. The rock looks like a re-cemented breccia or a conglomerate. In large masses the limestone is very pure, containing only a few fragments of reddish slate, amounting to perhaps one per cent. of the whole. That the limestone is in part original is proved by the indistinct crinoids, corals (cyathophylloids?), seen in parts of it. West of the limestone is a thick bed of limestone and slate conglomerate, the fragments being held together by a greyish cement.

The quality of the limestone in this locality is not as good as could be wished, the amount of iron present preventing its use in sugar refineries. The whole of the rock is perfectly suitable for building-stone, and most of it is pure enough for ordinary lime-making.

There appears to be a bar of rocks across the river, a quarter of a mile below the limestones, but it is affirmed locally that small boats can reach the stone at high tide. A considerable quantity was, in fact, shipped from here to Bundaberg some twenty years ago. The Calliope landing is only a mile below.

(*b*) PORTIONS 77 AND 78, AUCKLAND (WANMER'S).

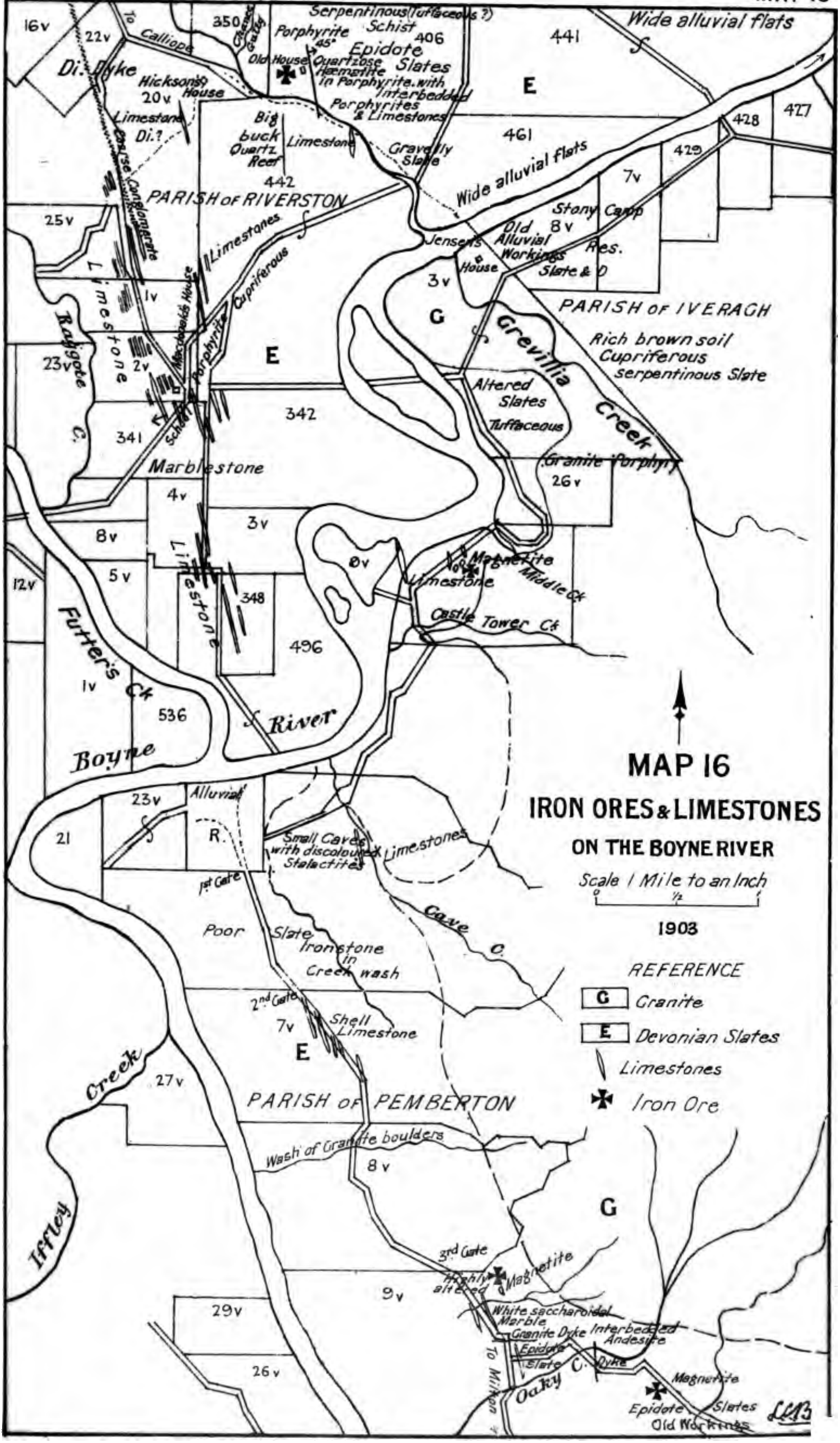
The deposits lie at the eastern ends of the portions, one mile from the Calliope River and eight miles south-west of Gladstone. (*See* Map 20.)

A small quarry has been opened on the deposit, which can be traced for several chains in a northerly direction, with a width of about two chains. The rock on the surface is much fractured, and the interspaces have been filled with red clay, staining the limestone and rendering it unfit for sugar refining. In the quarry the north-eastern part is rather impure, and when not actually impure internally it is much cracked, and the cracks are stained with ferruginous clay. The south-eastern portion is very pure.

Indistinct corals and crinoids are to be seen at times, proving that the limestone has been organically formed.

The position is a good one for exploitation, the road to the Calliope River having a gentle downward slope all the way. At the landing small 20-ton schooners are loaded, and if necessary the stone is transhipped at Gladstone.

Five hundred tons of limestone have been shipped from here to Bundaberg for the sugar refineries.



MAP 16
IRON ORES & LIMESTONES
ON THE BOYNE RIVER
Scale 1 Mile to an Inch
1903

2. CALLIOPE—MARBLESTONE—BOYNE.

From the 10-chain road two miles north of Calliope to the Eastern Boyne (15 miles) is a north-north-west belt of country one to two miles wide, in which very numerous outcrops of limestone are found. In the vicinity of the township of Calliope the outcrops are few and far between, but toward the head waters of Leixlip Creek they are more plentiful; the greatest development in the district is on the southern side of the Boyne Range, between Raggote Creek and the Boyne River, and owing to the size, persistence, and number of the beds, the locality has received the name of Marblestone. Beyond Marblestone, to the south, isolated outcrops occur at intervals almost to the head of the Boyne River. (*See* Locality Maps 11 and 19.)

(*a*) CALLIOPE.

(i.) On Marck's, portions 338 and 176, East Stowe, ten miles south of Gladstone, are three belts of non-fossiliferous limestone, one quarter of a mile in length and half a chain wide, striking about west-north-west. The limestone is very pure, and in fact the best seen in the district. Cartage to the landing on the Calliope River, a little over four miles distant, should not cost more than 4s. per ton. The distance from the outcrops to Annandale Station, on the Maryborough-Gladstone Railway, is seven miles by way of the 10-chain road, which presents no difficulties to teams. (*See* Map 24.)

(ii.) On the head of Bedford Creek, 2½ miles south-east of Calliope, are several outcrops of limestone.

(iii.) The first outcrop on Leixlip Creek is on the western side of the Marblestone road, two miles south-south-east of Calliope. Then numerous other outcrops occur on the heads of Ten-men Gully and Brennan's Flat.

(*b*) MARBLESTONE.

From Hickman's, portion 20, on the north, to portion 348, there is limestone practically all the way. The outcrops strike about north-north-west; as a rule they do not exceed a quarter of a mile in length, and owing to the development of separate lenses side by side the width is often as great as the length. (*See* Map 16.)

The greatest development is on portion 2v, Riverstone, beside the Calliope-Milton road, near the junction with a surveyed road, *viâ* Riverstone, to Annandale Railway Station (which is ten miles distant).

On portion 2v, the beds strike north 10 degrees west, and dip 70 degrees to east.

There is one large outcrop on the north and one on the south of the portion, but these are in all probability connected.

The limestones are, as a rule, pale blue or neutral tinted, mostly very pure, and therefore well adapted for lime-making. On portion 2v, the beds are highly fossiliferous, containing stromatopora (most abundant, forming whole beds up to 10 feet thick, in which the separate coral masses are often 18 inches or more across), cœnites, favosites, lithostrotion, cyathophylloids, cystiphyllum, &c., with a few shells. One belt in the limestone has the fossils replaced and preserved by silica.

There is also a belt of breccia, consisting of angular fragments of limestone in a red ferruginous cement. The bed is only a few feet in width, but outcrops for several chains. The rock takes a fine polish, and will hold its own with any of the imported breccia marbles.

(c) Boyne River.

Other extensive beds of limestone occur on portions 20v, 25v, 1v, 442, 341, 342, 4v, and 348, Riverstone—in fact, all along the Marblestone road. (*See* Map 16.) Very little of the stone is at all impure, most of it being light-blue in colour and granular in texture.

South of the Boyne, the first outcrops are on portion 22v, Pemberton, within quarter of a mile of the river.

There are other outcrops on Cave Creek, in portion 6v, Pemberton, about half a mile from the river.

In portion 7v, Pemberton, there are several outcrops of impure shell limestone, which would probably give good results as a hydraulic lime.

In portion 9v, Pemberton, there are several outcrops, one of which, on the road, is pure white, and saccharoidal in texture. The outcrop here is several chains in length. The limestone has been altered by the intrusion of the Many Peaks granite mass, which lies only half a mile to the east. This is quite sufficient indication to warrant extensive prospecting, but the demand gives no encouragement. The total Italian exports in 1902, a little over 327,000 tons, was valued at only 32s. a ton.

A probable continuation of the Marblestone belt is seen between Littlemere and Glassford Creek, at the head of the Boyne.

A 10-foot bed of pure white limestone lies two miles north of the Many Peaks Mine. It strikes north and south, and contains a few indistinct fossils.

A large outcrop lies about half a mile south of portion 10v, Milton. The bed is probably two chains in width, and can be followed for over a mile. The limestone is somewhat altered, but contains recognisable favosites, heliolites, cœnites, crinoids, bivalves, branching stenopora, and forams (?).

3. CATFISH.

A number of limstone outcrops occur on the Gladstone-Banana road, from the Catfish Hotel (which is 21 miles south-west of Gladstone) to the Wycheproof turn-off, three miles to the north-east. (*See* Map 17.) The beds have a general strike a little west of north, and the zone may possibly be a western extension of that at Calliope. The beds are up to one and a-half chains in width and half a mile in length, and the greater part is rather impure, though the stone in some of the beds (blue and grey) is sufficiently pure for lime-making. Some of the other beds are beautifully coloured. Fossil stromatopora, favosites, &c., are not very well preserved, though plentiful. Age—Devonian.

Other outcrops occur on the Calliope River, in portion 1v, West Stowe, about 20 chains above Ferguson's Crossing. The stone is a beautiful white marble, and would probably be of use for ornamental purposes.

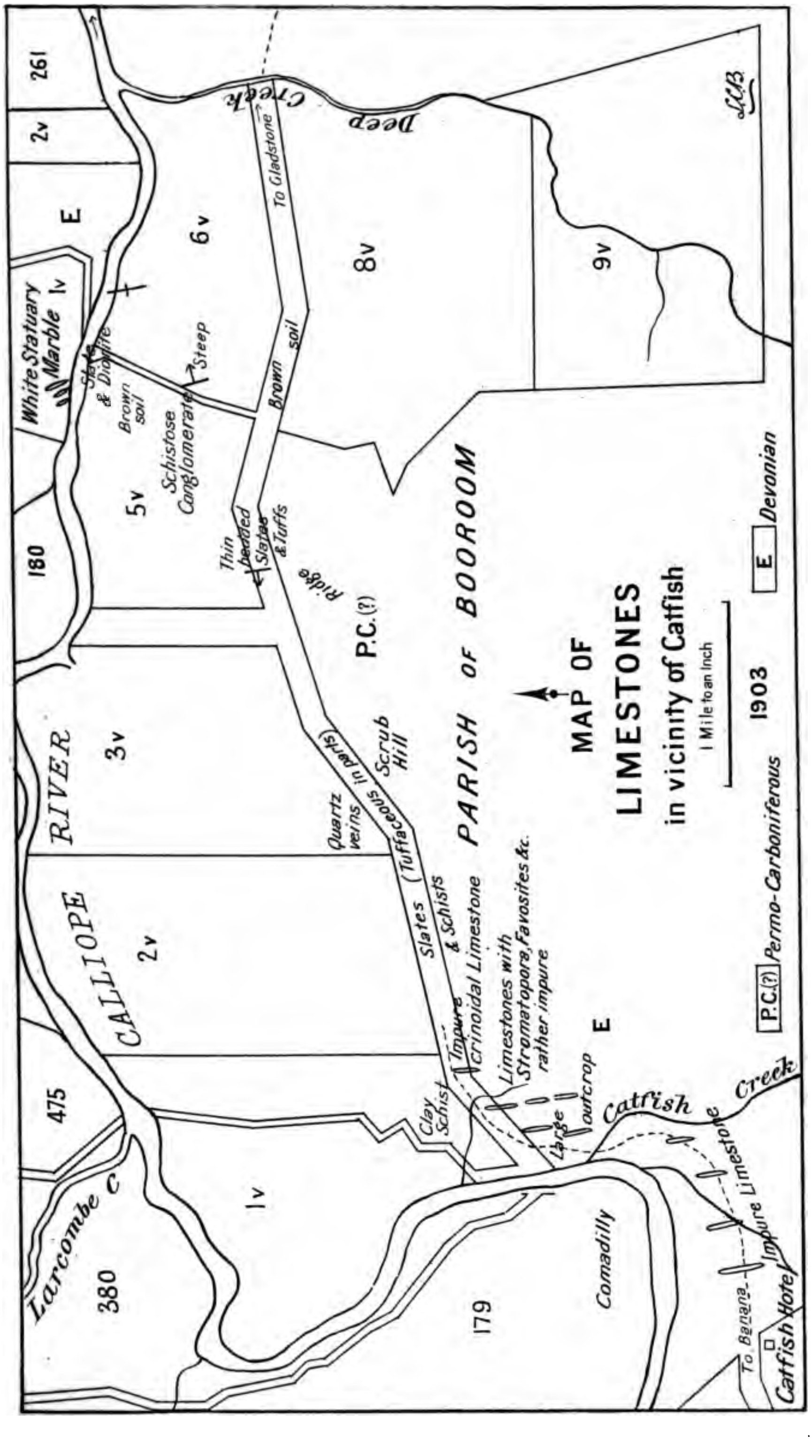
Several outcrops of marble occur on Mount Grim, on portion 2v, Alma, 31 miles west of Gladstone. The limestones have been highly altered, but still contain traces of corals and shells, pointing to their age being Permo-Carboniferous.

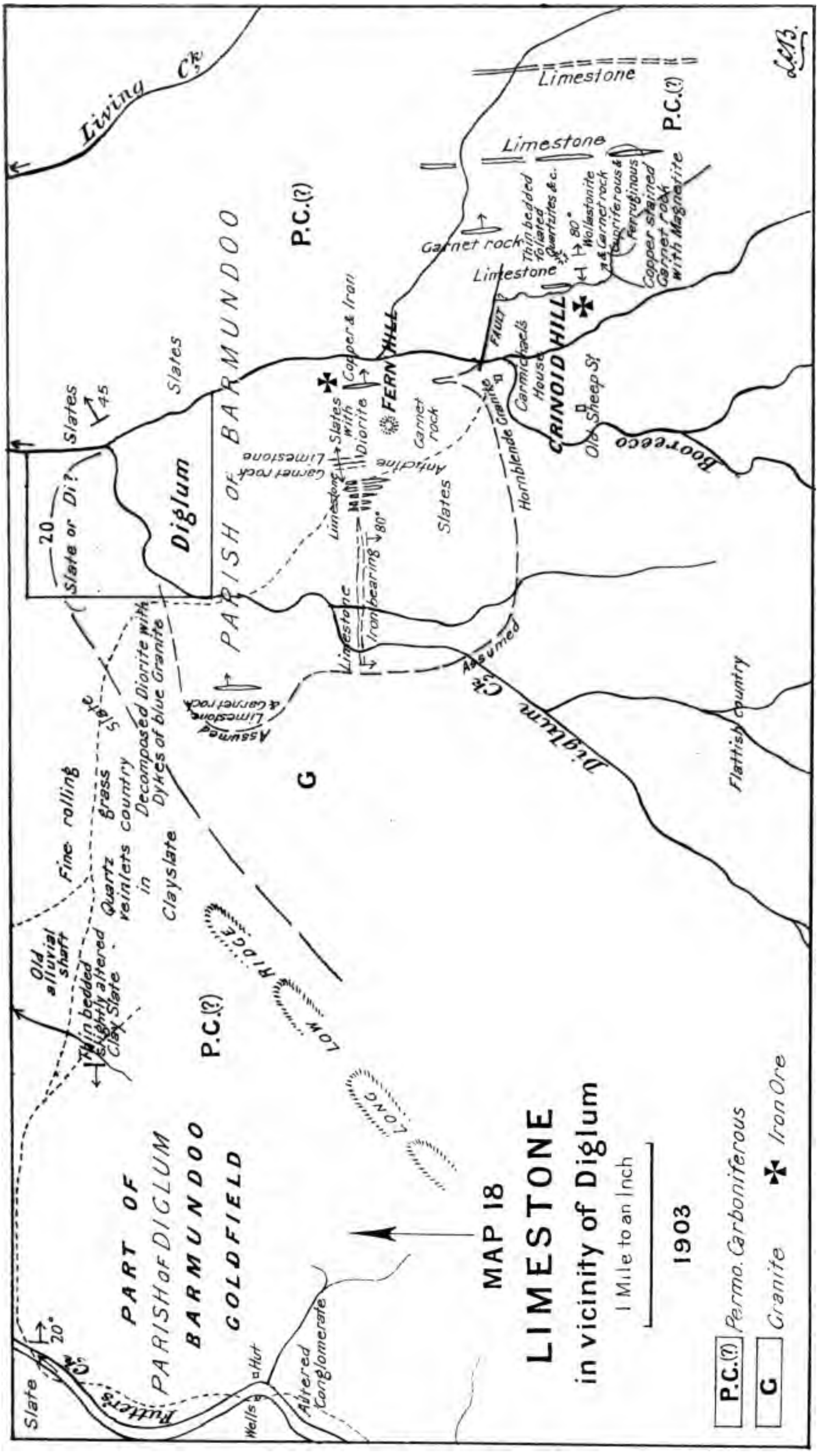
4. DIGLUM.

On Diglum and Booreeco Creeks, 30 miles south by west of Gladstone, are several north and south belts of limestone at intervals of half a mile, over an area four miles in diameter. Some of the limestones can be traced for over a mile. (*See* Map 18.)

Some of the limestone is very saccharoidal, but even then contains dendroid syringopora, beautifully preserved in silica.

GEOLOGICAL SURVEY OF QUEENSLAND **MAP 17**





MAP 18

LIMESTONE

in vicinity of Diglum

1 Mile to an Inch

1903

P.C.(?)	Permo. Carboniferous
G	Granite
✠	Iron Ore

Plate 9.

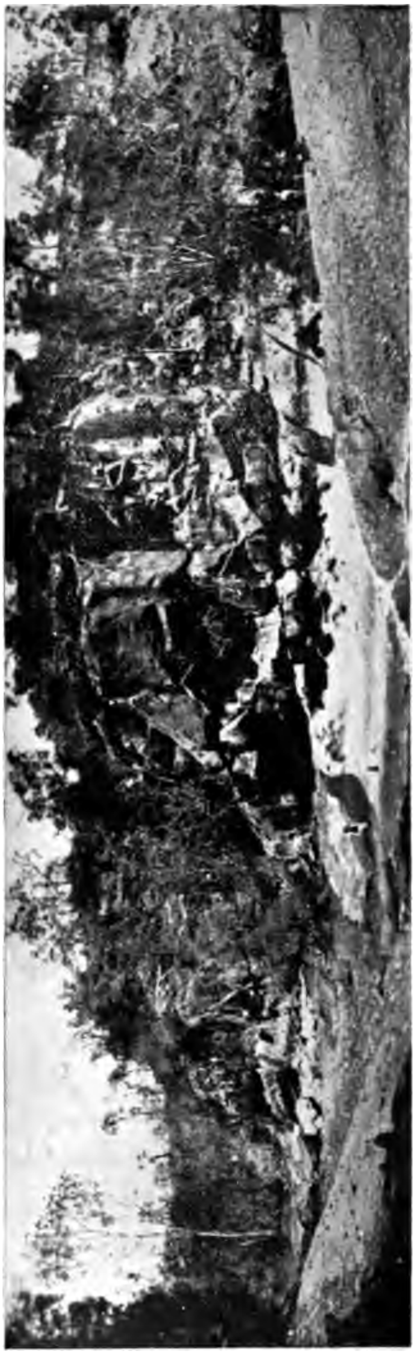


Photo., L.C.B.

Coralline Limestone, Kroombit

Some of the rocks here have been highly altered by the intrusion of a basic granite, which seems to extend to the head of Diglum Creek on the south. Wollastonite and garnet are found at several places near the junction.

The remoteness of the locality will prevent anything being done with these deposits for many years to come. They are here simply recorded, though already mentioned in a report of Mr. Dunstan's.*

5. KROOMBIT.

(*See* Map 11.)

Immense beds of fossiliferous limestone occur on Kroombit Creek, five miles above Kroombit Head Station. Exposure up to a quarter of a mile wide occur, and some of the cliffs on the creek are 50 feet in height. They are essentially coral beds, the lime being very pure.

The fossils include heliolites, stromatopora, and cœnites, with occasional shells and crinoids. The beds are believed to be of Devonian age, and within a mile to the west are tuff shales and sandstones overlying them unconformably, and containing zaphrentis, &c., and believed to be Permo-Carboniferous.

Other limestones occur at the Five-mile Copper Mines, five miles south-east of Kroombit, but have there been highly altered, and could only be of use for smelting.

6. GLASSFORD.

(*See* Maps 11 and 15.)

Several outcrops of limestone occur in the vicinity of Glassford Creek township, both north and south. It is in and near these limestones that the Glassford copper and iron ore occurs, and the limestones have been highly altered by the intrusion of granite. The limestones containing garnet rock are eminently adapted for smelting, but most of it is probably too siliceous for lime-making.

At Sandberger, some four miles south of Glassford, and at Mount Hector, some six miles north-west, similar highly altered limestones are found.

7. CANIA.

Oolitic limestones occur on both sides of Dawes' Range, on the Kroombit-Cania road, as well as at several places in the vicinity of Cania township, on both Four-mile and Three-Moon Creeks. The stone is light-blue in colour, and of a very good quality. Permo-Carboniferous fossils, martinia (?), pteronites (?), spirifera, and zaphrentis are occasionally found in them.

One outcrop, three miles west of Cania, is 50 feet thick and several chains in length.

Other beds are found on Spring Creek, five miles north-east of Cania, in very inaccessible country.

8. CANINDAH.

(*See* Map 11.)

Three large beds of limestones are crossed by the Canindah-Cania mail track in portion 7v, North Canindah, between Kalonga and Splinter Creeks. The stone on Kalonga Creek is pure, but most of that between Branch and Splinter Creeks is very impure, and suitable for nothing with the possible exception of hydraulic lime-making, and the inaccessibility of the locality will prevent its being worked for that purpose.

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* G.S.Q. Publication, No. 162.

C—Manganese Ore Deposits.

1. AREA, TOPOGRAPHY, AND TRANSPORT.

The area within which manganese ore has been found in the Gladstone district is roughly 15 miles in greatest length and 12 miles in greatest width—viz., from Targinie on the north-west, to Calliope on the south, and Quoin Island on the east. (*See* Locality Map 19.)

Between Gladstone, on the shores of Port Curtis, and Dawes' Range, 45 miles to the west-south-west, there are really no mountains, and most of the country within the manganese area is less than 100 feet above sea-level, the highest hills being not much over 500 feet in altitude. The rocks near the manganese deposits being generally indurated in character, have proved very resistent to atmospheric denudation, and consequently occur on the higher ridges and hills, such as One-tree Hill, Biondello, Mount Beecher, and Mount Miller. The soil over the greater part of the area is poor, the ridges being stony, the flats sandy. The ironbark on the ridges is the chief timber.

The influence of the strike of the strata is seen in the general northerly course of the Calliope River, of its tributary Saltwater Creek, and of Policeman or Auckland Creek, in the northerly pointing headlands about Gladstone, and in the northerly trend of most of the islands in Port Curtis.

Port Curtis has an average width of four miles, and from the mouth of the Calliope River to Gatcombe Head is ten miles, offering anchorage for a fleet, even though a large part is shoal.

Auckland Creek, beside which Gladstone lies, is really an inlet into the upper part of which Policeman Creek empties. It·is navigable owing to dredging for a few hundred yards from the end of Auckland Point—*i.e.*, to the wharves in the town, where boats of 1,000 tons burden can berth.

The Calliope is navigable for 12 miles above its mouth—*i.e.*, up to the bar at the entrance of Saltwater Creek—for boats of 300 tons, and beyond the bar up to the Mount Miller landing for boats of 100 tons, while 50-ton boats have been up to the marble bar at the Carrara Crossing. The present outlet for manganese ore is by the Calliope River, 20 to 50-ton schooners taking it up the Narrows to Rockhampton.

The Gladstone-Rockhampton Railway has now been opened, so that it is possible to rail to Rockhampton, Gladstone, or Brisbane.

2. GEOLOGY.

Of the Country as a Whole.

The manganese area consists, as a whole, of massive slates, quartzites, jasperoids, and sandy clay schists, variously intersected by dykes of trachyte, syenite, and diorite. The only other formations are the river and estuarine alluvials. Not a single fossil has been found within the area, but a little further west (at the Calliope Crossing) and south (at Marblestone), are limestones whose fossils prove the beds to be of Devonian age. The beds were shown as Gympie (Permo-Carboniferous) on the last large State geological map, but have been altered to Devonian on the later small map. The general strike of the strata is between north-north-west and north; the dip generally, where discernible, is to the east, and varies from 60 to almost 90 degrees.

Of the dyke rocks sanidine trachyte is found on Picnic Island, and on the Calliope road, just west of Gladstone.* Diorite and syenite outcrops are

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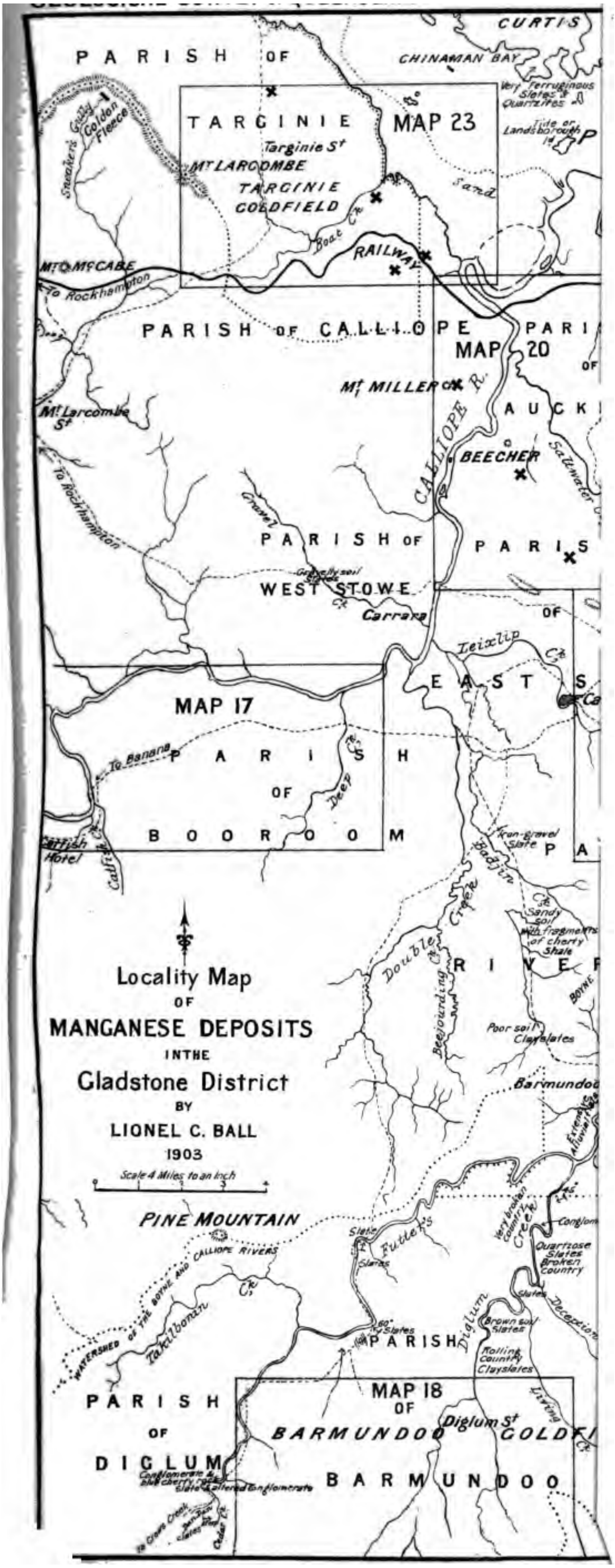
* Rep. on Goldfields in Port Curtis Distr., &c. By William H. R. G.S.Q.P., No. 21. Brisb.: By Authority, 1885.



Locality Map
OF
MANGANESE DEPOSITS
IN THE
Gladstone District
BY
LIONEL C. BALL
1903

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numerous between Annandale on the south and Targinie on the north, but most abundant between Skyring's Siding and the Gladstone reservoir. These dykes and the manganese deposits are in no way connected, there being no manganese where the dykes are most abundant, and as a rule no dykes in the vicinity of the ore deposits. Auckland Hill is an exception in that dykes occur at the base of the hill, though not adjacent to the deposits.

The typical surface country for manganese is hard, flinty, red or brown, sometimes quartz-veined jasperoid—clay slate, indurated and coloured owing to partial or complete replacement by silica and oxides of iron. These indurated rocks pass at from 20 to 50 feet depth into soft brown or yellow clay slate (or schist) or bluish quartzite.

Micro-sections show the jasperoid in the last stages to consist chiefly of minute prickly spheres of hæmatite in a base of secondary silica. Secondary silica also occurs in veins. Other specimens show slate partly replaced where much fractured. Search for radiolaria has been quite unsuccessful, everything pointing to the jasperoid being of secondary origin.

Of the Ore Deposits.

The deposits are lenticular, lying, with very few exceptions, with their longer axes parallel to the bedding of the slates. As a rule the outcrop is small, and the work thus far points to the depth of the lenses being no greater than their greatest length. There will probably be a number of overlapping lenses, extending to some depth, and only prospecting can determine whether these occur near enough to one another to be profitably worked. A fact noticed by prospectors is that the deposits in this district always pitch to the north, indicating a connection with cross fissures, which at Mount Miller separate rich and poor ore.

There cannot be the slightest doubt as to the secondary nature of most of the ore. That partly filling cavities in the Mount Miller deposit has a stalactitic and concentric structure, and in all the deposits specimens of slate and jasperoid can be obtained showing veins of manganese ore. Some of the ore has the structure of slate, which it appears to have metasomatically replaced, and specimens of slate partly changed into manganese ore are, in fact, not uncommon. It seems most likely that the manganese existed originally both as disseminations and small beds in the slates, which in all probability are deep-sea deposits; and further, that after the tilting of the slates the disseminated manganese ore was concentrated about the original beds, or possibly on lines of fracture, by carbonic acid solutions.

The ore deposits may be considered to form belts running about north and south with a tendency towards north-north-west—*i.e.*, parallel to the strike of the country. Gladstone is on one of these belts, extending northwards through the islands in Port Curtis, and southwards (through Round Mountain or One-tree Hill) to Biondello. The second belt crosses the Calliope River, six miles west of Gladstone, and extends from the railway line through Mount Miller and Mount Beecher south almost to Calliope.

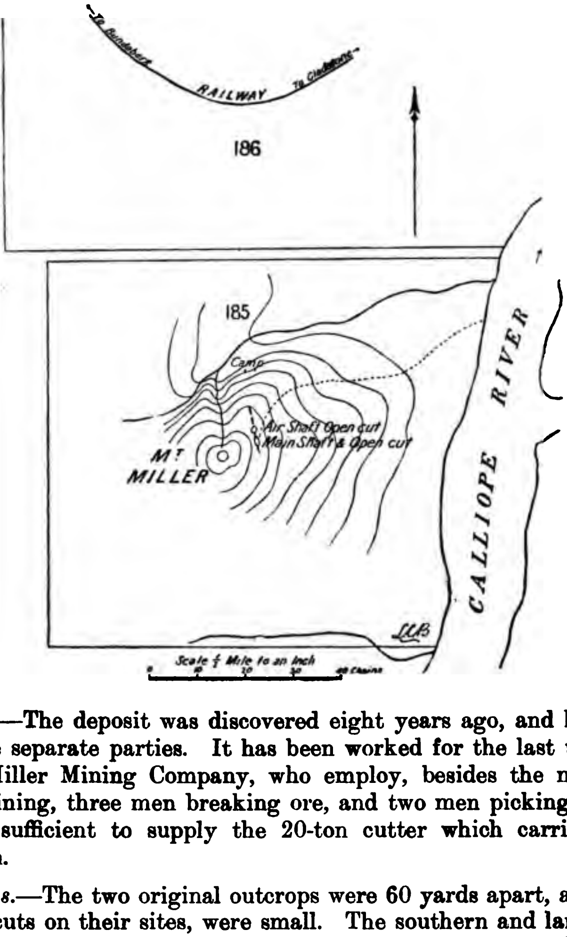
3. MINES.

The mines will be described in the order of their importance, judging from the amount of work done and the ore raised hitherto. It will be seen that only one, the Mount Miller, is now actually producing ore, though the Auckland Hill Mine should not be lying idle.

I.—MOUNT MILLER.

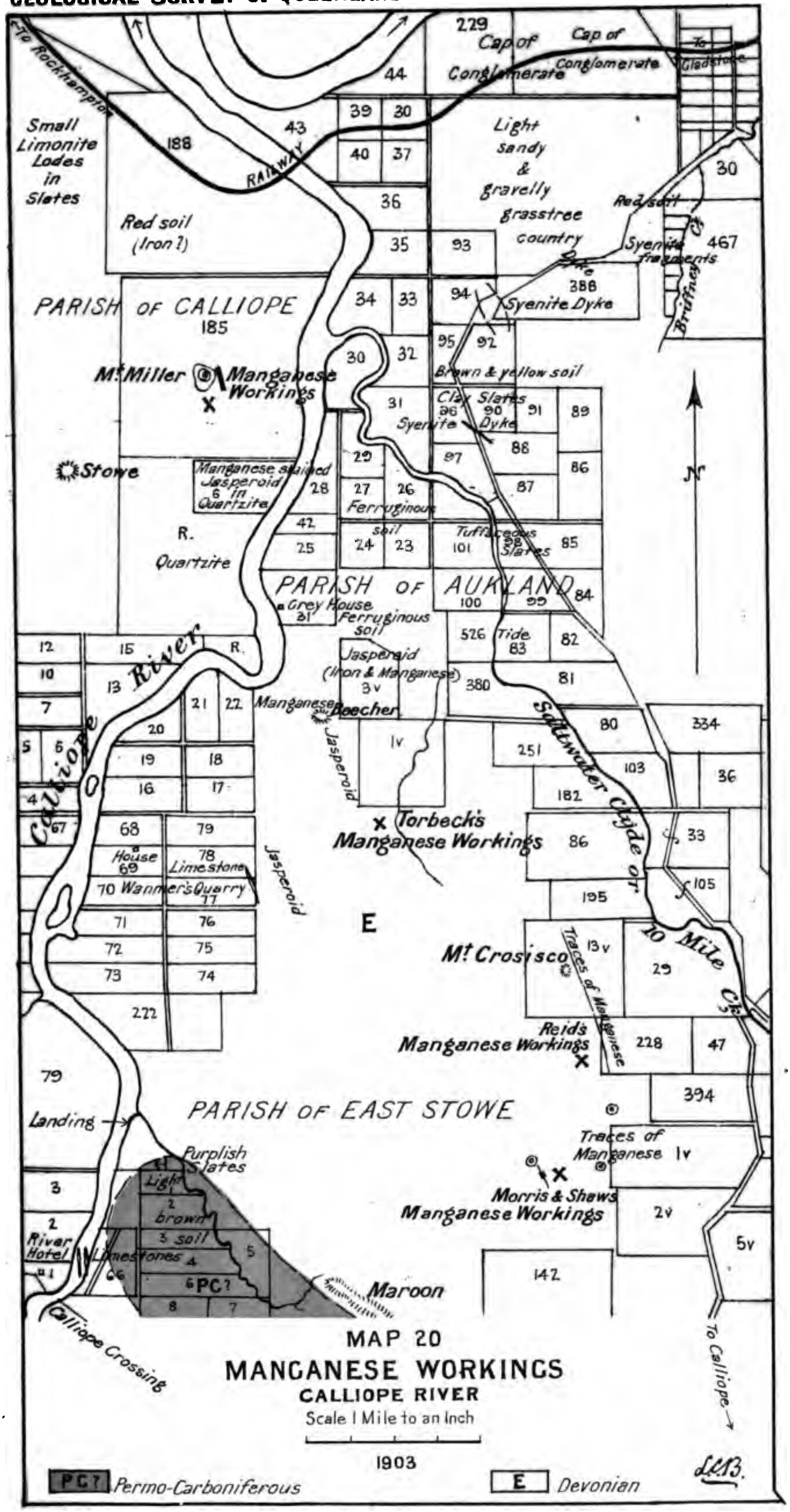
Locality.—Mount Miller is a hill in the centre of freehold portion 185, Calliope. (*See* Map 20.) The workings are near the summit, at an elevation of 400 feet above the Calliope River, from which the mine is one and a quarter miles distant by road. (*See* Fig. 3.) The position is an ideal one for exploitation by means of adits, and the short distances to water and rail greatly enhance the value of the property.

Fig. 3.



History.—The deposit was discovered eight years ago, and has since been held by three separate parties. It has been worked for the last three years by the Mount Miller Mining Company, who employ, besides the mine manager, three men mining, three men breaking ore, and two men picking and bagging. One cart is sufficient to supply the 20-ton cutter which carries the ore to Rockhampton.

Workings.—The two original outcrops were 60 yards apart, and as attested by the open cuts on their sites, were small. The southern and larger (No. 1) is only 25 feet in length, six to 12 feet wide, and 15 feet deep. (*See* Plate 10.) Reports differ as to the nature of the outcrop, but as it has been practically all quarried out it was probably payable ore. The main shaft has been sunk in this to a depth of 112 feet, and a ventilating shaft (No. 1 air shaft) in the northern open cut, has been connected with it at that level and also at the 50-feet level. (*See* Plates 11, 12, and 13.) The 50 and 112 feet levels have been connected by a third (the No. 2 air) shaft. A winze has been sunk to 50 feet below the 112-feet level at the northern end, and a crosscut connects it with the lode. Large stopes, 25 to 35 feet high, ten to 30 yards in length, and up to 20 feet in width, have been opened between the shafts above the 50-feet and the 112-feet levels.



MAP 20
MANGANESE WORKINGS
CALLIOPE RIVER

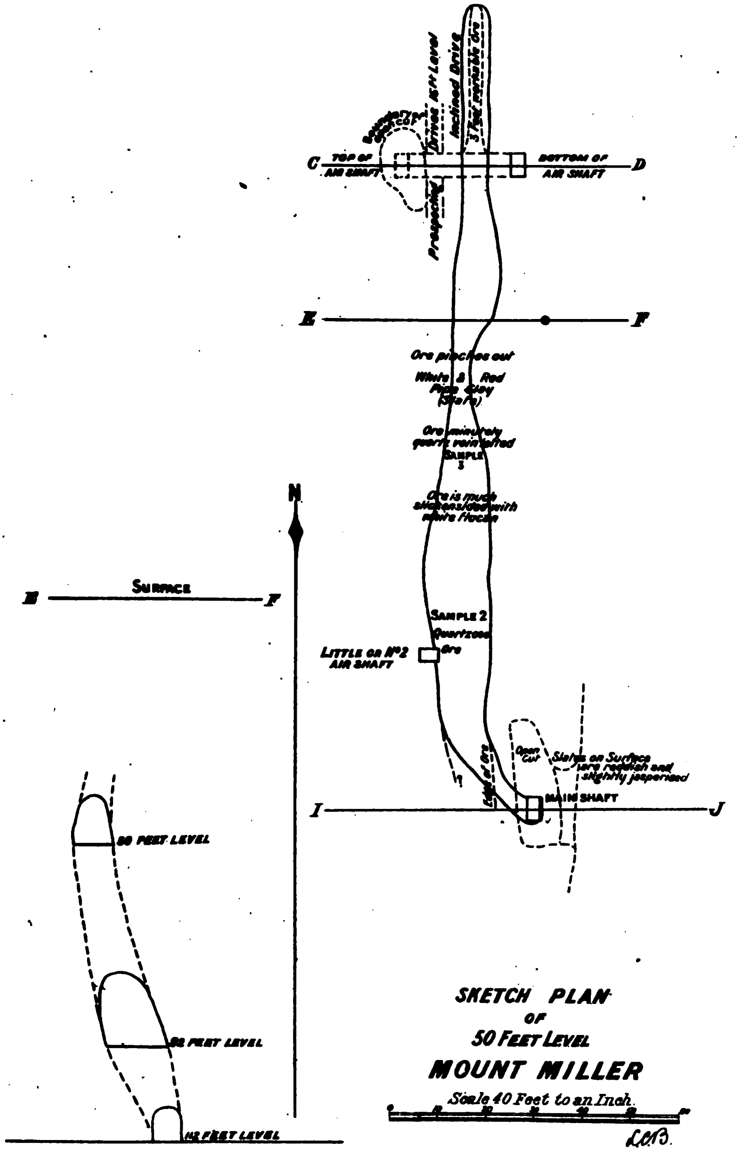
Scale 1 Mile to an Inch

1903

▨ PC? Permo-Carboniferous

☐ E Devonian

L.C.B.

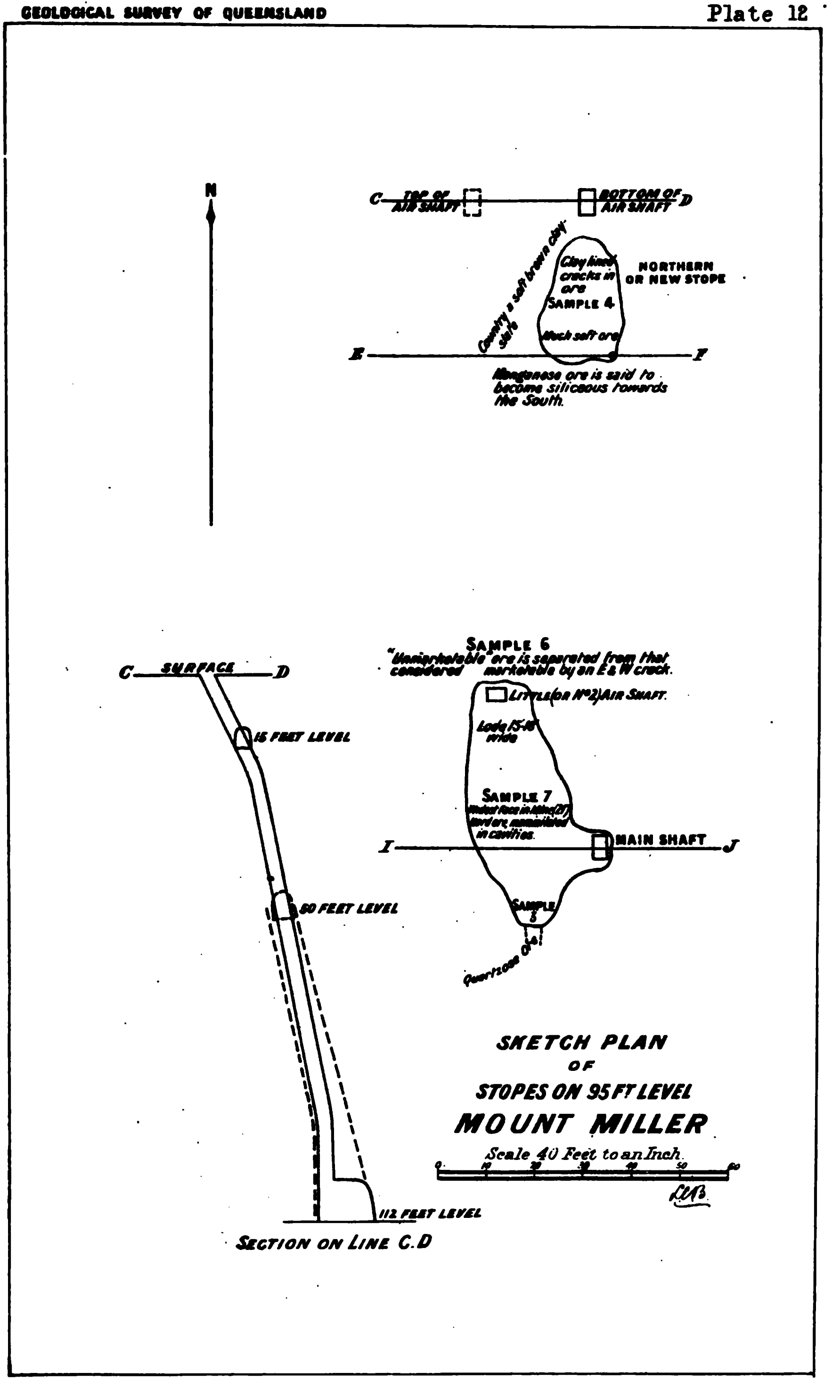


SKETCH PLAN
OF
50 FEET LEVEL
MOUNT MILLER

Scale 40 Feet to an Inch.

SECTION ON LINE E.F

L.C.B.

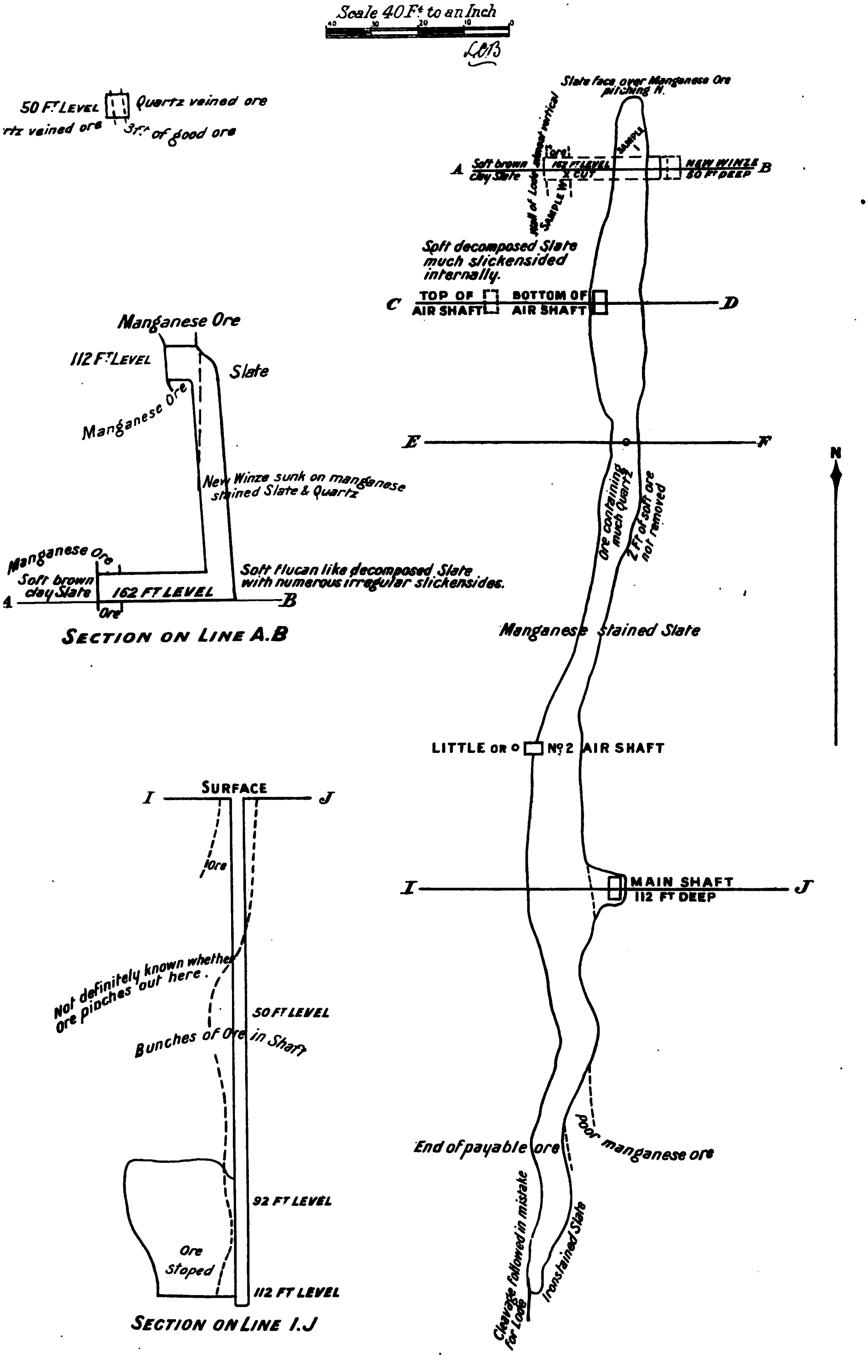

N
C
TOP OF AIR SHAFT
BOTTOM OF AIR SHAFT
D
Country a soft brown clay slate
Clay lined cracks in ore
SAMPLE 4
Much soft ore
NORTHERN OR NEW STOPE
E
F
Manganese ore is said to become siliceous towards the South.
SAMPLE 6
"Unmarketable" ore is separated from that considered marketable by an E & W crack.
LITTLE (OR No 2) AIR SHAFT.
Lode 15-18' wide
SAMPLE 7
Widest face in Mine (27') Hard ore, mammillated in cavities.
I
MAIN SHAFT
J
SAMPLE 8
Quartzose Ore
C
SURFACE
D
15 FEET LEVEL
60 FEET LEVEL
112 FEET LEVEL
SECTION ON LINE C.D
0
10
20
30
40
50
60
LCB

SKETCH PLAN OF STOPES ON 95 FT LEVEL MOUNT MILLER

Scale 40 Feet to an Inch.

SKETCH PLAN
OF
112 FEET LEVEL
MOUNT MILLER

Scale 40 Ft to an Inch



SECTION ON LINE A.B

SECTION ON LINE I.J

Plate 10.

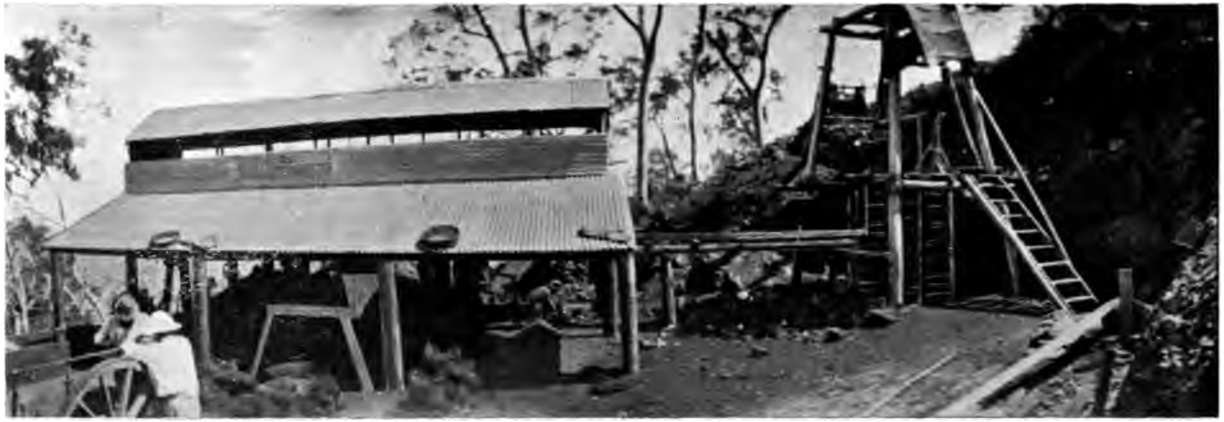


Photo., L. C. B.

Mount Miller Manganese Mine in 1902.
(Showing open cut, poppet legs, and sorting shed.)

It is proposed to run an adit from the hillside to the northern end of the deposit, at the 200-feet level. This the manager has calculated would be 400 feet long. An adit to the southern end of the deposit would be shorter, but owing to the broken nature of the country there much expense would have to be incurred in making a road.

Prospecting drives have been opened on the 15-feet level and on the 50-feet level (on the north), but beyond that, and continuing the 112-feet drive some 30 yards beyond where payable ore was found, little prospecting has been done. A crosscut to the east from the southern end of the 112-feet level is necessary. It is not definitely known what ore there is between the surface, the 50 and the 112 feet levels, though it could be ascertained by crosscuts from the main and little air shafts. Since my visit the main shaft has been sunk to 172 feet depth, and a crosscut to the west, striking ore within a few feet, continued in it for 29 feet. At the present time (April) drives are being opened north and south in this ore.

Ore Bodies.—As the plans show, the ore body is exceedingly irregular in strike, dip, and thickness. The average strike may be taken as north and south and the dip as vertical or coincident with that of the country.

The thickness of clean ore varies from three feet up to 21 feet. Latest advices report the body on the 172-feet level to be 29 feet in width.

Ore.—The typical ore, chiefly psilomelane but containing pyrolusite, and probably also braunite, is massive, and mostly steel-grey, passing into dull-bluish in bands and patches. It is sometimes honeycombed, and then the cavities are lined with a dead-black deposit of binoxide. At times it has the structure of slate, while in a few cases it is botrioidal and stalactitic, and is then found to be in concentric layers. The hardness of the ore is 6, the fracture is irregular and slightly conchoidal, and the streak is deep-brown and shining. Its specific gravity is 4.1. The ore is singularly free from the clay linings in cavities so characteristic of the ore from most of the other localities, silica and country rock being the chief impurities.

The mine manager has observed that the best ore is found where the country (clay slate) is softest, and thus far its hardness has decreased with depth, it being on the surface a jasperoid (hard, red, and flinty) while in the deepest workings it is a very soft clay slate (little harder than compressed clay).

The present ores may pass into carbonates in depth though no trace of such has yet been found. Even though, as seems most likely, the ore body should pinch at greater depth, another will eventually be picked up on further sinking and crosscutting, as on the 162-feet level.

A table of assays (Government Analyst) of samples taken by me is given below:—

Sample.	MnO_2.	Mn.	Fe.	SiO_2.	P.	S.
1. North end 112-feet level	—	30.3	—	—	—	—
2. South face in 50-feet level (90 feet from air shaft and 10 feet from little air shaft)	57.3	46.4	4.8	12.6	trace	—
4. North stope above 112-feet level (12 feet to 18 feet wide, "all good")	71.0	48.7	1.2	9.1	—	—
6. South stope above 112-feet level "unmarketable'	51.2	41.0	7.2	15.3	0.11	—
7. Face above 112-feet level (20 feet wide)	70.0	48.6	2.5	5.8	trace	trace
8. "Poor ore" thrown over tip	—	45.5	—	14.9	—	—
9. "Pickings' thrown over tip	—	41.0	—	—	—	—
W Bottom new winze (5 feet thickness)	54.1	37.5	4.2	—	—	—

There seems to be some prospect of a market being found for the ore in the United Kingdom in the near future, but at present the whole of the product from this mine goes to Mount Morgan. That delivered during 1901-1902 came from above the 112-feet level, and averaged 73.1 per cent. manganese dioxide. The average for 1902-1903 was the same, the highest assay being 75.8 per cent. (40 tons); the highest in 1903 was 76 per cent. The output during 1902 was the greatest, running from 100 to 120 tons a month, while that during the previous year was 80 tons a month. The lists of shipments received at Mount Morgan, given below, were kindly supplied me by Captain Richard:—

OUTPUT FROM MOUNT MILLER.

Year.	Ore.	Manganese Dioxide.
	Tons.	Per cent.
May to December, 1895	197½	69.66 to 76.84
January to May, 1896	46	65.8 ,, 72.94
January to October, 1897	419	55.09 ,, 71.91
May to December, 1898	529½	65.60 ,, 73.40
January to December, 1899	342	66.40 ,, 74.38
January to December, 1900	1,000	66.30 ,, 74.70
February to December, 1901	719½	70.50 ,, 75.30
January to November, 1902	949½	69.70 ,, 75.80
1903	1,350	74.1
	5,553	

The ore on the 172-feet level is proving to be the best yet handled, the latest return (April) having run 79.36 per cent. manganese dioxide.

The approximate value of the ore raised till the middle of 1902 was £15,000.

Treatment.—As the ore has to be bagged for shipment it is considered advisable to spall and handpick it to some extent, in order to raise the percentage of manganese dioxide. Ore in which specks and veinlets of silica can be seen is thrown over the tip, together with a large amount showing crystalline pyrolusite and ore too hard to break up. A sample of the material yields (Government Analyst):—

Manganese	45.5	per cent.
Silica	14.9	,,

There must be hundreds of tons of marketable ore in the tip. A sample of pickings from the "fines" thrown on the tip assays (Government Analyst):—

Manganese ... ... 40 per cent.

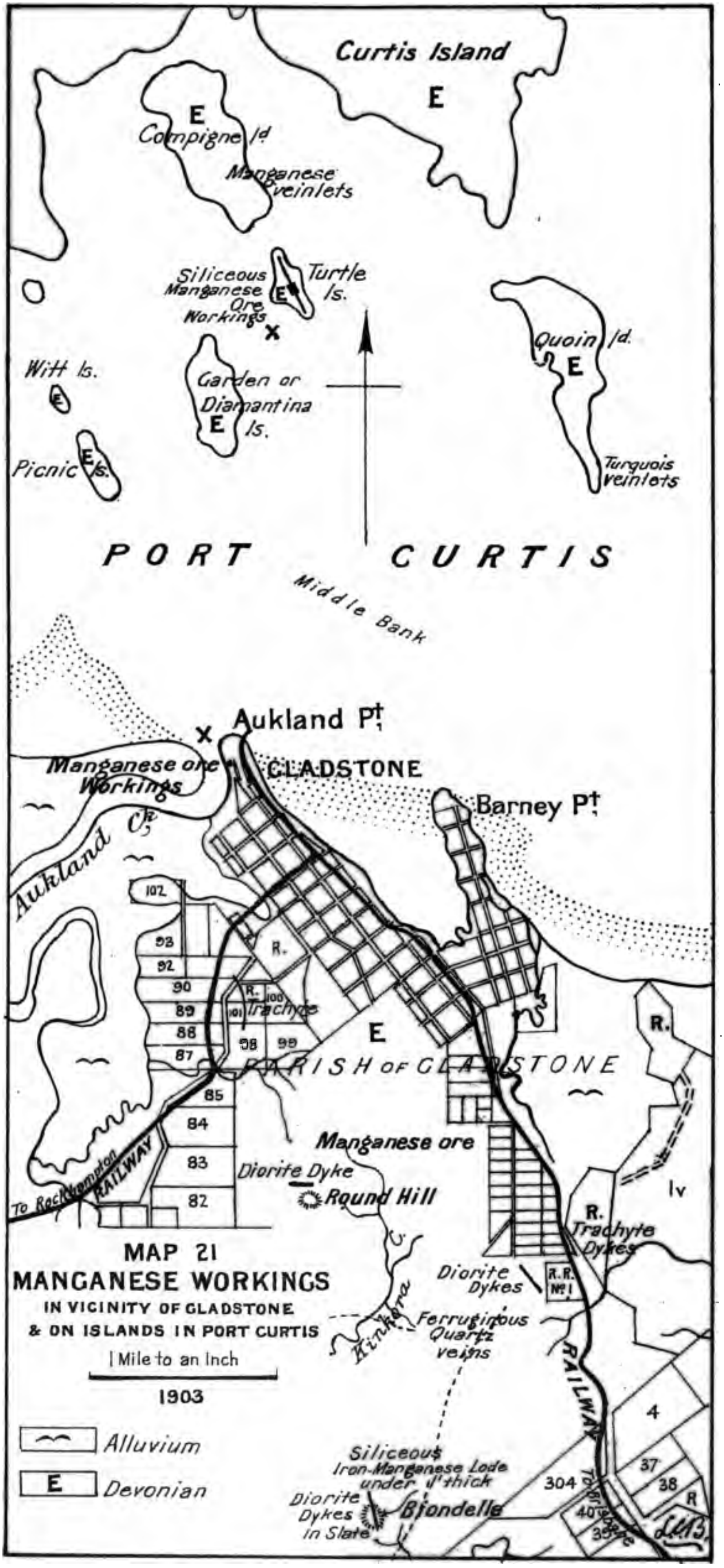
When the mine was visited the ore was raised by whip and windlass, but steam winding-gear has now been purchased, so that the output can be increased at shortest notice.

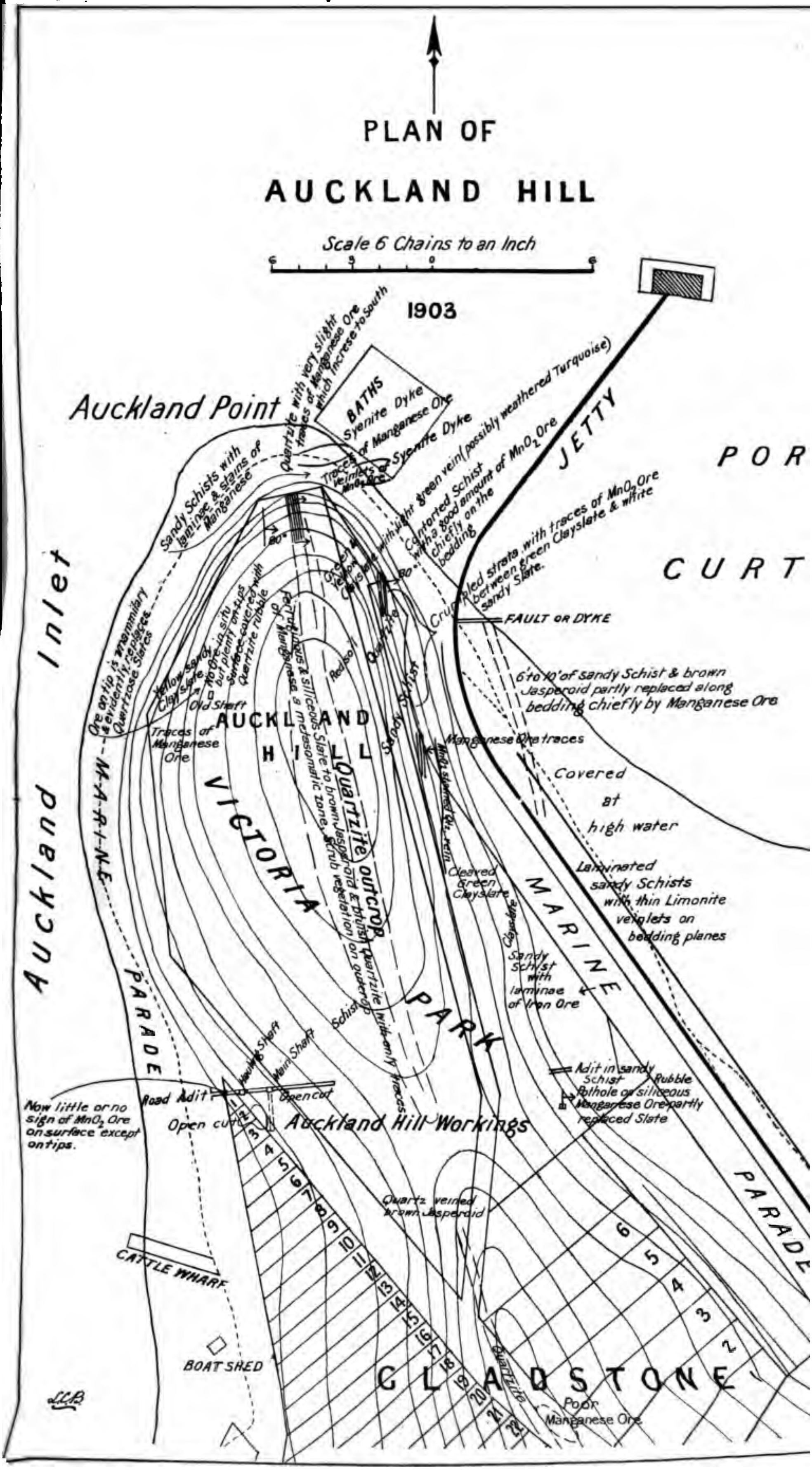
The exact cost of mining, sorting, and freight to Rockhampton is not available, but the amount is probably not much more than £1 per ton.

II.—AUCKLAND HILL.

Locality.—Auckland Hill, forming Auckland Point, is the extreme northern end of the ridge on which Gladstone is built. (*See* Map 21.) Although leased for mining purposes it is a recreation reserve, and is known by the Gladstone Municipal Council as Victoria Park. Its area is 12 acres. On the

GEOLOGICAL SURVEY OF QUEENSLAND **MAP 21**





PLAN OF

AUCKLAND HILL

Scale 6 Chains to an Inch

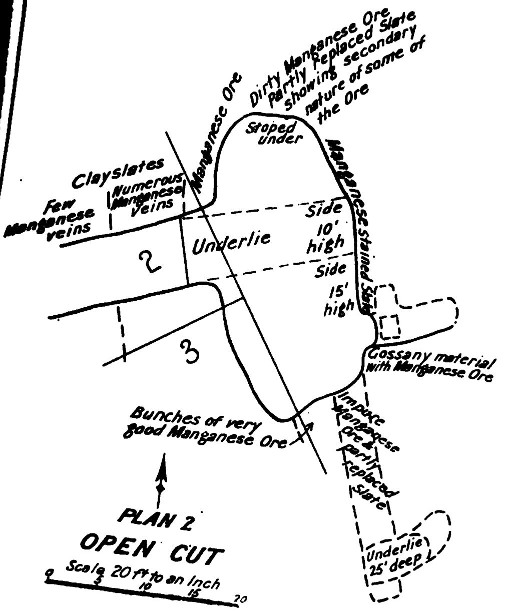
1903

6
3
0
6
Auckland Point
BATHS
Syenite Dyke
of Manganese Ore
Syenite Dyke
Quartzite with very slight traces of Manganese Ore which increase to south
Traces of veinlets of MnO2 Ore
Green vein (possibly weathered Turquoise)
Contorted Schist with a good amount of MnO2 Ore chiefly on the bedding
JETTY
PORT
CURT
Sandy Schists with laminae & stains of Manganese
Clayslate with light
Crumpled strata with traces of MnO2 Ore between green Clayslate & white sandy Slate.
FAULT OR DYKE
6 to 10' of sandy Schist & brown Jasperoid partly replaced along bedding chiefly by Manganese Ore
Manganese Ore traces
Covered at high water
80°
Green Yellow
Red soil
Quartzite
Sandy Schist
Ore on tip is mammillary & evidently replaces Quartzose Slates
Yellow sandy Clayslate
No Ore in situ but plenty on tips
Surface covered with Quartzite rubble
Old Shaft
Traces of Manganese Ore
AUCKLAND HILL
Ferruginous & siliceous Slate to brown Jasperoid & bluish Quartzite with only traces of Manganese, a metasomatic zone, scrub vegetation on outcrop
Quartzite outcrop
VICTORIA PARK
Auckland Inlet
MARINE PARADE
MnO2 stained Qz. vein
Cleaved Green Clayslate
Clayslate
Sandy Schist with laminae of Iron Ore
Laminated sandy Schists with thin Limonite veinlets on bedding planes
MARINE PARADE
Schist
Winding Shaft
Main Shaft
Road Adit
Opencut
Open cut
Auckland Hill Workings
Now little or no sign of MnO2 Ore on surface except on tips.
Adit in sandy Schist
Rubble
Pothole of siliceous Manganese Ore partly replaced Slate
Quartz veined brown Jasperoid
CATTLE WHARF
BOAT SHED
GLADSTONE
Quartzite
Poor Manganese Ore
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
6
5
4
3
2
L.C.B.

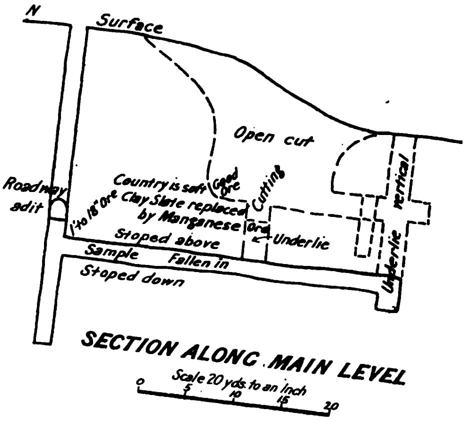
OLOGICAL SURVEY OF QUEENSLAND

AUCKLAND HILL MANGANESE MINE

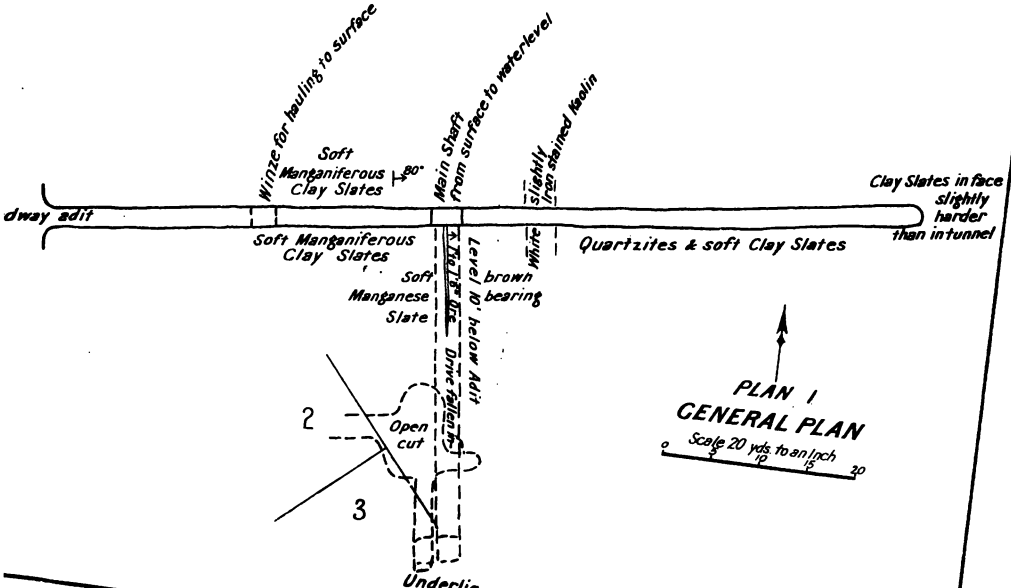
1903


Manganese Ore
Dirty Manganese Ore Partly replaced Slate showing secondary nature of some of the Ore
Stoped under
Clayslates
Few Manganese veins
Numerous Manganese Veins
Underlie
Side 10' high
Side 15' high
Manganese stained Slate
2
3
Gossany material with Manganese Ore
Impure Manganese Ore & partly replaced Slate
Bunches of very good Manganese Ore
Underlie 25' deep
Scale 20 ft to an Inch
0 5 10 15 20

PLAN 2
OPEN CUT



SECTION ALONG MAIN LEVEL


Winze for hauling to surface
Soft Manganiferous Clay Slates
80°
Main Shaft from surface to waterlevel
slightly iron stained Kaolin
Clay Slates in face slightly harder than in tunnel
dway adit
Soft Manganiferous Clay Slates
Soft Manganese Slate
1' to 1'8" Ore
Level 10' below Adit
Drive fallen in
White brown bearing
Quartzites & soft Clay Slates
2
Open cut
3
Underlie
Scale 20 yds. to an Inch
0 5 10 15 20

PLAN 1
GENERAL PLAN

LCB

Plate 15.

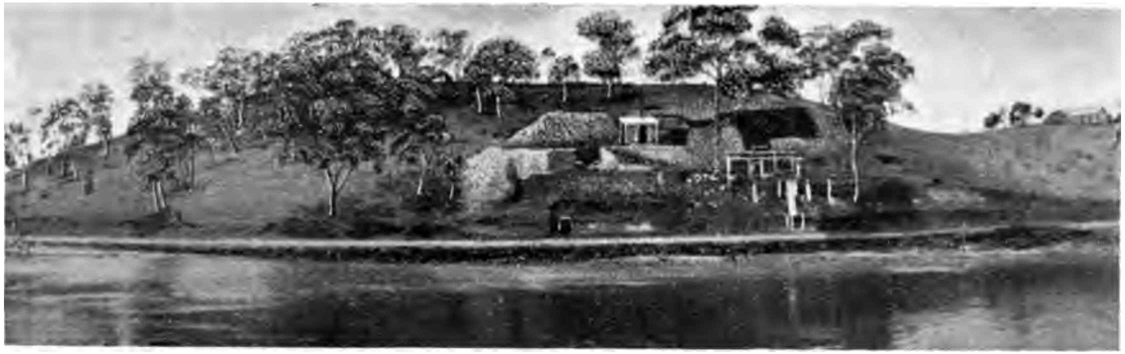


Photo., L.C.B

AUCKLAND HILL MANGANESE MINE.
(Viewed from the West.)

east is Port Cutris, with the Government jetty for large boats; and on the west is Auckland Inlet, with wharves for the smaller vessels, making the position an ideal one as far as shipping is concerned. (*See* Plan 22.)

History.—Work was first begun here in 1882, with the intention of exporting the ore, but operations had soon to be suspended. The ore has been attacked from time to time since then, principally to supply Charters Towers and Mount Morgan, most of the work being done by the late Mr. Spiro, during 1895, 1896, and 1897. The mine now lies idle in the hands of a Toowoomba syndicate.

Workings.—The main workings (*see* Plate 14) are on the western side of the hill, but one shaft has been sunk on the north, and proved the existence of ore within five chains of the point, and quite lately a pot-hole has been opened in the south-western corner of the park in six feet of slate, partly replaced by manganese ore. An adit was put into the hillside below and a little to the north of this, but failed to find more than a trace of manganese. Therefore that deposit either has the form of a lens or it has "pitched," or it has been faulted. The first is most probable.

The main workings include an open cut with various short crosscourses; an adit 90 yards in length level with the municipal roadway, which is only a few feet above high-water mark; three shafts from the surface; and a main drive 35 yards long connecting the northern and southern shafts.

A general view of the mine is given in Plate 15.

The country consists of soft clay slates, which in places in the main adit are almost free from iron stains, and have been proved to be suitable for pottery.

Ore.—The ore occurred in bunches of up to 20 or 30 tons, connected by stringers. While inspecting the vein in the main drive there was no doubt in my mind that ore has there replaced slate. As the main shaft reaches a little below sea-level, and is only 70 yards from Auckland Inlet, there has been a great influx of brackish water, which has thus far prevented sinking, though it is said the ore in the lower part of the shaft is better than that above the water.

The ore is massive, and consists of a mixture of psilomelane, pyrolusite, and braunite; it has a submetallic lustre and steel-grey colour with brown streaks; its hardness is 5.5, and its specific gravity is 3.8. That raised always contained a considerable amount of clay, and had to be washed before shipment. For this purpose a crude form of rocking-table was employed, being connected by a rod to the flywheel of the engine used for hauling.

The ore exported by Mr. Spiro contained an average of 67 or 68 per cent. manganese dioxide. A shipment of ore from the main shaft, raised by Mr. Torbeck in 1901, ran 77 per cent. manganese dioxide. A sample was taken from the few tons bagged now on the surface; it assays (Government Analyst)—

Manganese	46.7	per cent.
Manganese dioxide ...	69.4	,,
Silica	7.6	,,
Iron	2.2	,,
Phosphorus	0.33	,,
Sulphur	trace	

The phosphorus is objectionally high, if the ore be required for speigeleisen. The element, however, probably occurs in the clayey impurities, which may be expected to decrease below water-level.

The following shipments have been received at Mount Morgan:—

Year.	Ore.	Manganese Dioxide.
	Tons.	Per cent.
May to October, 1895	100	68.55 to 77.63
January to December, 1896	278	56.18 ,, 74.94
January to September, 1897	480	43.6 ,, 72.93
July to September, 1899	117	67.5 ,, 69.87
January to October, 1900	298½	52.65 ,, 77.4
	1,273½	

III.—MORGAN'S AND REID'S.

Locality.—Morgan's workings lie three-eighths of a mile west of the eight-mile bench mark on the Gladstone-Rockhampton Railway Line. (*See* Map 23.)

History.—Morgan began work about six years ago, and during three years obtained a couple of hundred tons of ore. The ground then lay abandoned for two years, when Reid took it up and secured 18 tons 15 cwt. of ore.

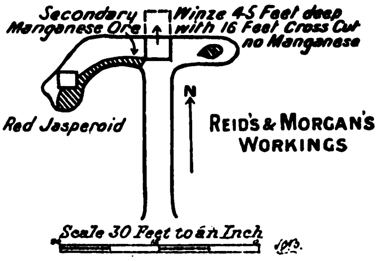
Workings.—A line of trenches and small shafts runs up the side of a ridge in a west-south-west direction for a distance of five chains.

Reid's workings are on the ridgetop, where some of the surface ore is said to have been 5 per cent. better than that at Mount Miller, but much of the ore, though hard and metallic-looking, contained only 40 per cent. MnO_2. The deposit struck north-west, and pitched in the same direction. The country rock here also is a hard red jasperoid slate, with white quartz veins, causing "pseudo-breccia" (exactly the same in appearance as that at Mount Colo, north of Kilkivan*).

The main shaft is 110 feet deep, with crosscuts 30 feet in length to north and 20 feet to south in country at the bottom. At 70 feet depth is a drive for 12 feet to north-west and 35 feet to south-east, also in country. At 35 feet depth a 15-feet incline drive to the north-west picked up ore at five feet from the shaft, but at the end it became very poor.

About five chains north-west of the main shaft the jasper has been apparently brecciated and infilled with manganese oxides. A few large bunches of ore were worked out by Morgan. Reid opened an adit about 20 feet below one of these, and then connected the old and new workings with a winze. Two bunches of ore were struck, one 15 feet long and one to five feet thick, and one three feet in diameter. They yielded about eight and a-half tons of ore. The sketch appended shows how irregular the deposits were. (*See* Fig. 4.)

Fig. 4.


Secondary Manganese Ore
Winze 45 Feet deep with 16 Feet Cross Cut no Manganese
N
Red Jasperoid
REID'S & MORGAN'S WORKINGS
Scale 30 Feet to an Inch

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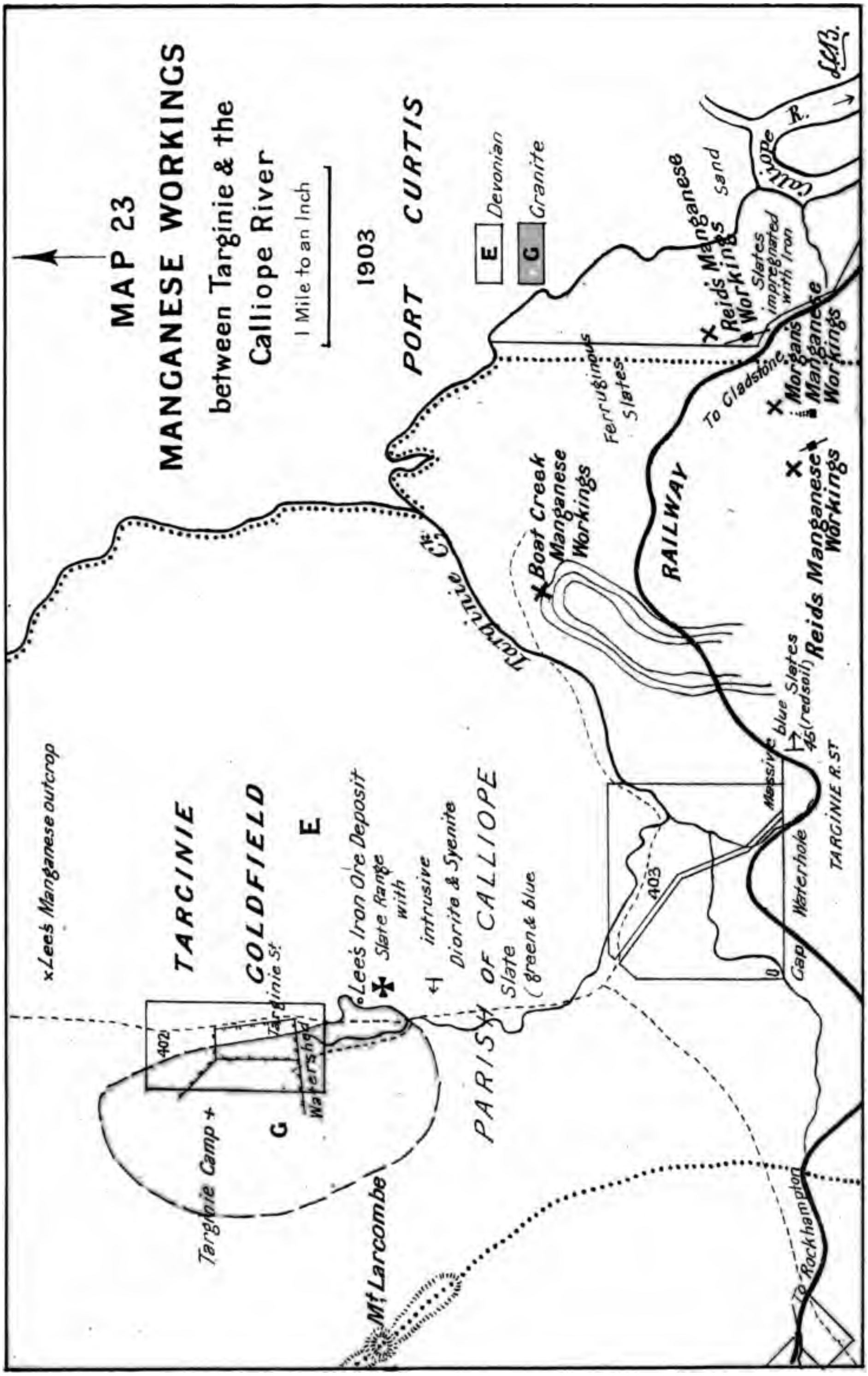
* *See* G.S.Q. Report No. 179.

GEOLOGICAL SURVEY OF QUEENSLAND **MAP 23**



Ore.—There appear to have been a number of north and south lenses connected by cross branches, in a red jasperised slate. Ore was never found at a greater depth than 20 feet, and the deposits seem to have been at least partly in a residual clay—*i.e.*, concentrated owing to disintegration and denudation of the country rock. There is a large area of red soil, and tons of shoads are said to have been collected, but ground was broken only where a block outcropped.

The following shipments have been received at Mount Morgan:—

Year.	Ore.	Manganese Dioxide.
	Tons.	Per cent.
August and October, 1897	42½	69.2 to 69.65
April to December, 1898	122½	67.1 „ 72.70
May, 1899	18½	66.43
	183½	

IV.—BOAT CREEK.

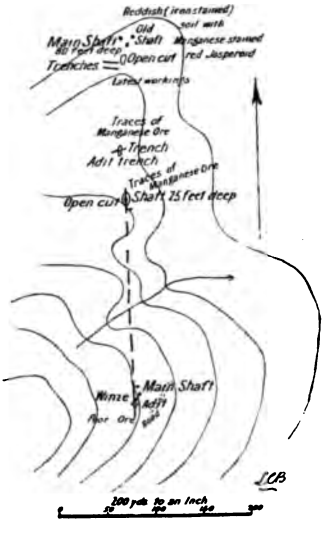
Locality.—Boat Creek workings are on the end of a rocky redsoil spur, about 150 feet above the flats south of Boat or Targinie Creek, seven miles west of Gladstone. (*See* Map 23.) They are now abandoned. A reward claim was taken up by D. McIntyre in May, 1902, but the ground had been held long before that.

Workings.—More trenching has been done on this hill than in the whole of the remainder of the Gladstone district, but no large deposits have been exposed, so the red colour of the soil must be due to iron disseminated in the slates.

It was not possible to examine any of the shafts, as all ropes and ladders had been removed. Very little is to be seen on the surface. The mine was abandoned because operations failed to locate further deposits of ore at a reasonable outlay.

Ore Deposits.—Bunches of ore occurred in two zones connected by manganese-stained country. Some of the ore from here has a better appearance even than that from Mount Miller. Several hundred tons of good ore (lowest 68 per cent., highest 70.8 MnO_2), are reported to have been taken from the latest workings on the north. (*See* Fig. 5.)

Fig. 5.



The following shipments have been received at Mount Morgan:—

Year.	Ore.	Manganese Dioxide.
	Tons.	Per cent.
May to November, 1901	79	65.5 to 69.7
April to August, 1902	65	68.4 „ 70.8
	144	

V.—SHAW AND MORRIS.

Locality.—This deposit lies three and a-half miles due north of Calliope and eight and a-half miles south-south-west of Gladstone. (*See* Map 24.) The distance by road to the landing on the Calliope River is four and a-half miles, practically all down hill.

Workings.—It was discovered three years ago by Cairncross, who held it for six months, and obtained from an open cut about ten tons of ore, which still lies at grass. The ground was taken up later by Shaw and Morris, the original lessees of Mount Miller, and worked for eighteen months. They sank two shafts, still open to a depth of 20 feet, at which level in the northern shaft are a drive for ten feet to the west, and an incline for 40 feet to the east.

Ore.—The ore raisd by Cairncross assays (Government Analyst):—

Manganese dioxide ...	69.5	per cent.
Manganese	46.7	„
Iron	2.7	„
Silica	4.5	„
Phosphorus	0.14	„

The following shipments have been received at Mount Morgan:—

Year.	Ore.	Manganese Dioxide.
	Tons.	Per cent.
January to October, 1900	36	69.2 to 71.7

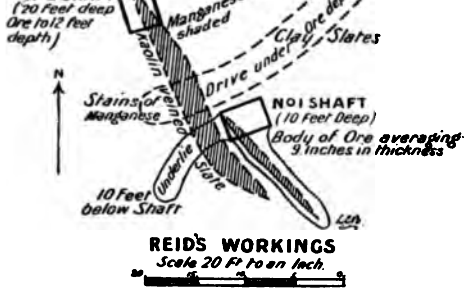
VI.—REID'S.

(*See* Map 12.)

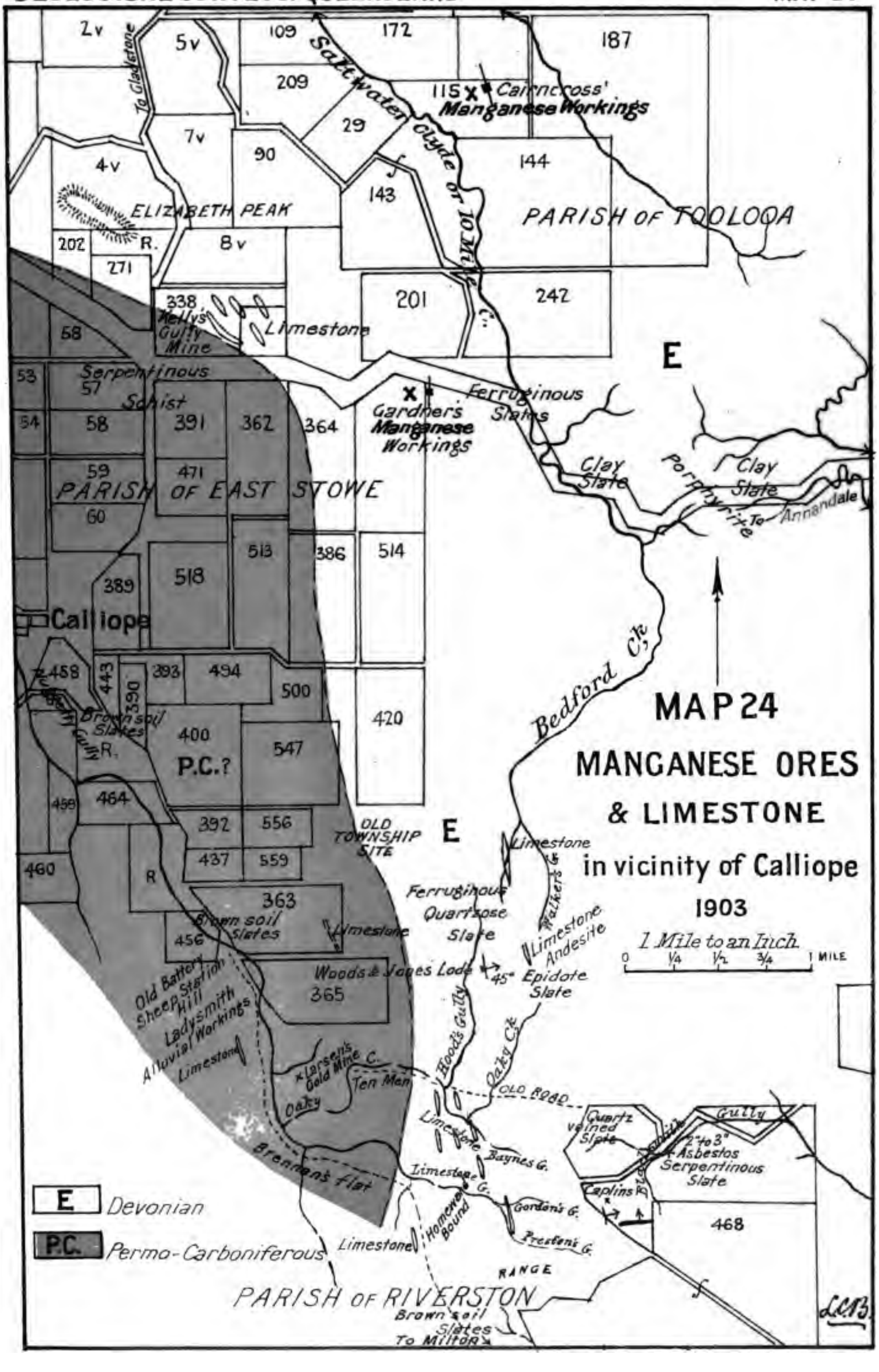
Locality.—Reid's Mine is on the western side of portion 1v, Calliope, about five chains north-east of the railway line, seven and seven-eighths miles from Gladstone. (*See* Map 12.)

Ore Bodies.—Lenticular bodies within 12 feet of the surface yielded 20 tons of good ore.

Fig. 6.



GEOLOGICAL SURVEY OF QUEENSLAND **MAP 24**



Workings.—Two shafts were sunk on the ore bodies, beneath which a crosscut from a third shaft proved only stains of manganese. (*See* Fig. 6.)

VII.—CAIRNCROSS.

Locality.—These old workings are on freehold portion 115, Toolooa, four miles north-east of Calliope and nine miles due south of Gladstone. (*See* Map 24.)

Workings.—The deposits were first worked in 1882, when a shaft was sunk 30 feet, and a pothole one and a-half chains north of it, and on the opposite side of the ridge, was opened.

Ore Bodies.—The ore body in the shaft yielded 30 tons of ore before pinching out in quartzose slate, striking north-west. This ore had to be washed to remove a coating of clay. Another bunch of 15 tons of cleaner ore was obtained from the pothole; this is said to have been vertical, but nothing of it can now be seen. Blocks of ore have been found right to the boundary of portion 172. On the surface the ore is rather siliceous, but it improves at a depth. The ore raised was sold in Gladstone for £3 per ton and thence shipped for Charters Towers.

The cost of cartage to the Calliope River was then 7s. to 8s. per ton and to Gladstone £1, which would now be 10s. or less. The royalty required by the owner of the ground is 1s. per ton.

VIII.—ONE-TREE (OR ROUND) HILL.

(*See* Map 20.)

Martin's (abandoned).—Old workings, about half a mile south-south-east of the Hill. A couple of potholes show iron-stained clay slate, and a little slate partly replaced by manganese ore, and one shows a little impure psilomelane, not however worth further prospecting. There is a small diorite dyke striking north-north-east a few yards east of the workings.

Fry's (abandoned).—These lie north 35 degrees east from the Hill. In one pothole thin bedded clay slates strike north-north-east and dip very steeply to the west-north-west. An underlie shaft was opened for about nine feet on two to three feet of rather poor manganese ore, dipping with the country 45 degrees. The hanging-wall country is friable, but the footwall into which the ore gradually fades is chalcedonic. The ore body is worth prospecting, and an attempt has been made to sink a shaft ten feet from the outcrop, but was given up after sinking a few feet.

Foote's (abandoned).—Within 100 feet of the top of One-tree Hill is a tunnel 100 feet in length, crossing the slates in a direction west by south. The slates dip three in one to the west, and are practically all iron and manganese stained, which accounts for the redness of the soil on the hill. No lode was found.

Jones's (abandoned).—The workings are on the brow of a ridge three-quarters of a mile north-north-west of the Hill. The country is manganese-stained ochreous slate with small fragments of manganese ore. A shaft and several potholes have been opened on small bunches of ore. Trenches are needed to prove whether there is anything permanent here.

IX.—GARDNER'S (CALLIOPE).

Locality.—The outcrop of this deposit is on the one-chain road on the eastern side of portion 364, East Stowe, and just south of the ten-chain road. (*See* Map 24.)

Ore Body.—It consists of four feet of decomposed clay slate with lumps of ore, forming beneath the surface a mass from six inches to three feet in width, apparently striking east and west.

Occasional blocks have been found on the surface for a few chains north and south, pointing to that being the strike. A shaft was sunk vertically on the original outcrop to a depth of 20 feet, and the body was followed on the underlie from 20 to 30 feet depth. Another mass of ore on the south side of the shaft not yet broken into is probably a continuation of the deposit on a north and south line.

Ore.—Much of the ore is practically ironstone, and the best ore on the surface is reported to contain only 55 per cent. manganese dioxide. A sample taken from ten feet depth assays (Government Analyst):—

Manganese dioxide ...	43.6	per cent.
Manganese ...	29.7	„
Iron	22.1	„

X.—TORBECK'S (KIRKWOOD'S, MOUNT BEECHER).

(*See* Map 20.)

Locality.—One mile south-east of Mount Beecher and seven miles south-east of Gladstone.

Torbeck's Ore Body.—A small bunch of ore, on which a vertical shaft is being sunk by Mr. Torbeck, gave way within a few feet to black manganese-stained country rock, found when broken into to consist of chalcedonic and jasperoid slate, with bunches of ore; this forms a belt a chain in length, four to six feet wide, and containing more or less manganese ore to a depth of 20 feet. It strikes north-north-west, and on the surface dips 1 in 4 to the west-south-west. It is proposed to sink and then drive. At a depth of 25 feet in the shaft the dip is changing towards east-north-east, and slight traces of manganese are to be seen at 30 feet depth. There is always a possibility of ore being struck in such country as this, but there is nothing very promising here as yet. Only five tons of ore have been obtained, and represent perhaps ten per cent. of the material removed.

Kirkwood's Workings.—Four chains south of Torbeck's shaft is a pothole on a small manganese deposit striking north-north-east and dipping east-south-east (perhaps only locally). Thickness is as much as a foot in places, but in others the ore fades into red jasperoid slate.

The footwall country is soft red clay slate, streaked with white in a similar manner to the footwall country near the little air shaft in the Mount Miller Mine. This deposit may open out, but it gives no definite promise of doing so.

Kirkwood's old shaft is on a vertical fissure, ten feet east of this pothole. It is 50 feet deep. At the surface the eastern wall is vertical and plain, but the western wall is often replaced with iron and manganese.

Ore.—About ten tons of ore from Kirkwood's shaft lie on the surface; blocks of it up to a foot in diameter have the structure of slate, and are probably metasomatic after it. An analysis of a sample of the picked ore is (Government Analyst):—

Manganese dioxide ...	54.4	per cent.
Manganese	37.7	„

XI.—MOUNT CROSISCO.

Locality.—Mount Crosisco (*see* Map 20) is in the centre of portion 13v, East Stowe, eight miles south-south-west of Gladstone.

Country.—Red jasperoid and manganese-stained and replaced slates, striking north-north-west, outcrop and produce a reddish-brown soil for a couple of hundred yards down the northern side of the mountain. The country is worth prospecting by trenches.

Reid's pothole is on manganese-bearing jasperoid, about five chains south of portion 13v, and ten chains from portion 228. There are traces of manganese in jasperoids about ten chains south-west of this. The country here is serpentinous slate, of a different character to any seen elsewhere in the district. The whole locality is worth prospecting, though very little ore is to be seen.

XII.—TARGINIE.

Locality.—Manganese ore (a single block weighing about a hundredweight), was found a mile north-east of Targinie township, on the northern end of a low ridge. (*See* Map 23.)

Ore.—The ore is massive, black, and glossy, with a strong conchoidal fracture, and a black and shining streak. Its hardness is 6.5, and its specific gravity 3.7. Specimens of red jasperoid, partly replaced by quartz, are found on the surface.

Workings.—A shaft has been begun in decomposed reddish and purplish slate, which five feet from the surface is stained with manganese. Owing to the good quality of the ore it is worth sinking a shallow shaft here to prospect the ground.

XIII.—ISLANDS IN PORT CURTIS.

Traces of manganese are to be found on several of the islands north of Gladstone. (*See* Map 21.)

On the highest point, and in the centre of Turtle Island, a small quarry has been made on a band of slate ten feet wide, and partly replaced by manganese and quartz. The ore obtained was probably payable, but none that now remains could be utilised for any purpose.

On the east side of Compigne Island, and at the south end of Picnic Island, are numerous half-inch veinlets of very good manganese ore, but nothing workable.

Indefinite rumours are also heard of manganese on Curtis Island, which was not visited.

XIV.—KROOMBIT.

In the vicinity of the old furnace area at the Five-mile Copper Mines, already referred to, several fragments of manganese ore were observed. No prospecting has, however, yet been done for deposits of the ore.

4.—CONCLUSION.

I.—*Markets.*

At the present time there is in Queensland a limited local demand for high-grade ore (70 per cent. MnO_2) only, which has been easily met by the one mine now working in the Gladstone district. The demand is that of the

Mount Morgan Gold Mining Company, who require the dioxide for the generation of chlorine, 100 tons a month sufficing at present. The company, naturally not wishing to be dependent on one mine, has greatly encouraged prospecting in this as well as other districts. Thus far the results in the Gladstone district have been disappointing, the deposits found, with the exception of the Mount Miller, proving small and irregular. From their nature the deposits must always be considered difficult and uncertain, as well as expensive to work on any scale.

Imports of ore have been made by the Mount Morgan Company from New Zealand and Java, but the shipments always contain much less dioxide than the first samples sent, and the company consider the local supply the best procurable.

Prospecting in the past has been for ore for this market only, but when steel-works are erected in Australia there will be a strong demand, even for ore such as that at Gardner's, Calliope, low in manganese, but high in iron.

The only other local demands for manganese ores are potteries, chemical works, and smelters, but their total consumption is very small.

Doubt is often expressed locally as to the possibility of working the local deposits, owing to the immense quantitites in Russia and Brazil, but there is encouragement in the consideration that these are never all high-grade ore, well situated, nor suitable for all industries. Then, as in Russia the railway freights are very high, and deliveries are so uncertain that many consumers are glad to buy elsewhere. In Brazil the deposits are over 200 miles from the coast, freight thus eating up much of the profits.

II.—*Value of the Ore.*

In the home markets manganese ore containing over 50 per cent. manganese has been quoted during the last few years at about—generally a little less than—1s. per unit. The English quotation for January, 1904, was 9¼d. per unit, and the American 1s. 0½d., for 50 per cent. ores containing less than 8 per cent. silica and 0.1 per cent. phosphorus. With these values it would require 55 per cent. ore to pay expenses alone (putting mining at 10s., cartage at 5s., and freight to England at 25s.). As there is no likelihood of special vessels being chartered, owing to the available supply being insufficient, we have no present prospect of an extensive export trade.

I should like to acknowledge the assistance rendered by many people in the district, especially Messrs. Torbeck, Reid, Miller, Baker, Fisher, Cairncross, and Gardner.

III.—MARYBOROUGH DISTRICT.

A—Iron Ore Deposits.

1. MOUNT BIGGENDEN.*

Locality.—The mine lies five miles south of Degilbo, and is four and a-half miles by road from Biggenden Railway Station, which is 54 miles from Maryborough. Howard, the centre of the Burrum Coal Field, is 72 miles distant by rail.

Amount.—The amount of iron ore actually proved by the workings is only about 80,000 tons, but very little prospecting would be necessary to expose a much larger quantity.

Workings.—(*See* plans given with Report quoted.) The worked ground is included in an east and west direction, within three and a-half chains, and in a north and south direction within seven chains. The workings consist of three open cuts, an adit, a main shaft, and various drives and crosscuts. The main shaft is 150 feet deep.

Ore.—The main deposit consists of magnetite with patches of calcite and disseminated bismuth ores. A belt of slate ten feet thick on the west separates the main magnetite outcrop from a smaller one. There is another body, not worked, east of that exposed in the main open cut. The magnetite shows no thinning at the 145-feet level.

Treatment.—Being raised for gold and bismuth, at the present time, the ore is hand-picked to a limited extent at the surface. After crushing, the pulp from the mills is washed over Frue vanners, the concentrates from which are dried on a furnace and fed into a magnetic concentrator of the revolving-cylinder type, with a capacity of seven tons vanner concentrates per 12 hours. The magnetite thus separated is practically free from impurities.

The amount of limestone in the immediate vicinity of the mine is unlimited, one bed a few chains to the east being 30 feet across, and extending for a quarter of a mile, with a proved depth of 145 feet.

The gold and bismuth separated magnetically from the iron should pay for the cost of crushing and separating a very pure iron ore for the furnaces.

2. GAYNDAH.

The range top, five miles south of Gayndah, is capped in places with a considerable thickness of laterite, altered in places into limonite and turgite. One of these caps was lately taken up as a prospecting area for gold and silver. It is a curved plateau, 15 chains in length and up to five chains wide, the greater part of the surface of which, as well as much of the slopes, is covered with blocks of limonite and turgite (hydrated sesquioxide of iron), varying from dull-brown to bright-red, and from a soft powder to a compact solid. At several points a white aluminous rock can be seen, either filling pipes in the limonite or else as blocks with joints filled by that mineral; but practically 95 per cent. of the outcrops are iron ore. The deposit may, for the talus hides the lower part, have a maximum thickness of 50 feet at the southern end, gradually tapering out to the north-west in thickness as well as in width. Thus there should be over a million tons of ore here.

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* Mount Biggenden Gold and Bismuth Mine. By L.C.B. 1902. By Auth.: Brisb. G.S.Q.P., No. 173.

A general sample from the whole surface assays (Government Analyst):—

Iron	33.4
Silica and insoluble ...	35.7
Phosphorus	0.1

The lower ridge running north from the above is also capped with limonite.

The limonite rests on flat-bedded white cherty sandstones and shales, which will probably prove to be of Cretaceous age. Similar rocks exist as far south as Brovinia Creek, and as far west as Dykehead—in fact, cap the greater part of the intervening country. Limonite, perhaps less pure even than that at Scotland's Hills, occurs at a great number of localities in this area; and all grades, from the pure mineral through ferruginous beauxite to only slightly stained beauxite can be found. My opinion is that these limonites represent the residuum of former beds of volcanic tuff or mud, or even lava, and that they belong to the Cretaceous beds with which they are always associated.*

B—Limestones.

1. DALESFORD.

Dalesford is a siding on the Bundaberg-Mount Perry Railway Line, 36 miles from the former place, and 31 miles from the latter. All the limestone deposits hitherto worked are within a distance of five miles to the south-south-east of the station.

PORTION 1317, WALLA (Toban's).

Three main lines of limestone occur in the south-eastern corner of the portion, five miles south-south-east of Dalesford Railway Station.

The country rock is highly-altered slightly-contorted clay schist, with intercalated lenses of quartz, and it is noticeable that where quartz is most strongly developed limestone is absent, and *vice versâ*; in only one place in the district was quartz seen in association with limestone. The dip—45 degrees to 60 degrees—varies from south-south-west to south-west.

The main body of limestone here is over a chain in width, and is traceable for about five chains, when towards the north it gradually tapers out, while towards the south it is covered with detritus. A quarry, a chain in diameter (ten chains from the south-eastern corner of the portion), has been opened to 15 feet depth on this outcrop, and exposes a bed of limestone 15 feet thick, with 25 feet additional limestone, including bands of schist. The limestone is bluish and laminated and in places is very impure. Part of the stone quarried was burnt in an adjacent kiln dug out of the hillside.

Another quarry (15 feet deep and a chain long) five chains west of the above, is now worked; the bed varies from ten feet to a chain in width, within a distance of three chains, and the dip is here 50 degrees to the west.

The limestones contain absolutely no trace of fossils, and though now massive show traces of thin bedding. Before breaking the rock it is impossible to distinguish it from the slate, and it probably represents a metamosatically replaced sediment. It contains pyrite in places, which, though an advantage at Mount Perry, would be objectionable for steel-making.

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* Reported Gold Find at Scotland's Hills, near Gayndah. By L.C.B. *Queensland Government Mining Journal*, March, 1904, vol. 5.

In July last 3,000 tons had been sent away, and of this 1,000 tons went to the Milaquin Sugar Refinery. Much of this material was obtained from the original outcrops.

The cost of quarrying is 2s. 3d. per ton, and of cartage to Dalesford 6s. The central mill tramline now reaches to within one and a-half miles of the quarries, and it may in the future be worth while to extend it to them.

PORTION 7V, WALLA (Stevens's).

Stevens's quarry lies about half a mile south-west of Toban's. It is only ten feet across, though the limestone, which is slightly more homogeneous than Toban's, is 30 feet wide and three chains in length. Other outcrops can be picked up for miles to the south.

This is the only place where limestone and quartz were found in contact. The country is clay schist, with large blows of hungry white quartz containing films of secondary muscovite on cracks. This quartz near the quarry gives way quite suddenly to limestone.

The best limestone from here has assayed 96 per cent. calcium carbonate, but a little is so stained with oxides of iron and clay that it is useless.

STEVENS'S MINERAL SELECTION.

This lies about ten chains south of the last quarry. On the surface the stone ten yards across is almost white, but becomes dirty-blue at 15 feet depth. The limestone here gives way in the most abrupt manner to slate, opposite sides of joints being slate and limestone. This is further evidence of replacement.

It is reported that there are numerous other outcrops of limestone south of this, and there is thus probably a belt extending down to Tenningering Head Station, where limestone is known to occur in large quantities, but owing to its geographical position, quite unavailable at present.

PORTION 1230, WALLA (Thiel's).

The limestones are in the eastern end of the portion, half a mile west of Toban's quarry. The strata here strikes north and south, and dip 80 degrees to the west. The limestone seems to have developed on the northern side of a fault striking west-north-west. It varies from light-blue to yellow in colour, and has every appearance of having replaced thin bedded slates. Slabs six inches thick and two feet six inches square can be obtained without any trouble.

A quarry three chains long and one chain in width is now being worked, but outcrops of limestone occur for over two chains to the east, and again five chains to the north-east is another bed of deep-blue limestone. During the fifteen months previous to my visit 7,000 tons of stone had been sent away, while the total exported from the whole district was computed as 10,000 tons, valued at £4,000.

OTHER OUTCROPS.

On the Crown land two miles south-east of Dalesford several claims have been pegged out, but the limestone beds here, which are vertical, and strike north and south are generally, as far as proved, less than three feet in thickness.

The stone is, however, variously coloured—pink, blue, and green—and would, if in quantity, be of value for building purposes. The country rock is chloritic schist with disseminated octahedral crystals of magnetite.

2. BIGGENDEN AND DEGILBO.

Considerable beds of limestone occur in a belt running south from Biggenden and Degilbo* (the latter the terminus of a railway from Maryborough).

Though large quantities of stone sufficiently pure for lime-making can be had between the two towns, the greater part of the deposits is rather impure. This would, perhaps, be rather an advantage than otherwise in a flux. The limestones near the Biggenden mines are often garnetiferous, and admirably adapted for fluxing.

3. GIGOOMGAN.

There are in the neighbourhood of Gigoomgan Head Station large outcrops of limestone of all degrees of purity, from marble to calcareous shale.†

A belt of more highly altered limestone occurs to the south of this, midway between the Degilbo and Kilkivan branch railways.‡

C—Manganese Ore Deposits.

1. GIN GIN.

The manganese deposits in the Gin Gin district have been dealt with in detail in a separate report.§

Very little work has been done on the deposits as yet, the outcrops only having been tested, and they average considerably below 70 per cent. manganese dioxide. There is, however, promise of the deposits increasing in size and quality below the surface.

2. DEGILBO.

The deposits in this district are referred to in the above report. Though the ore is slightly richer than that at Gin Gin, the quantity apparently available is only a few tons.

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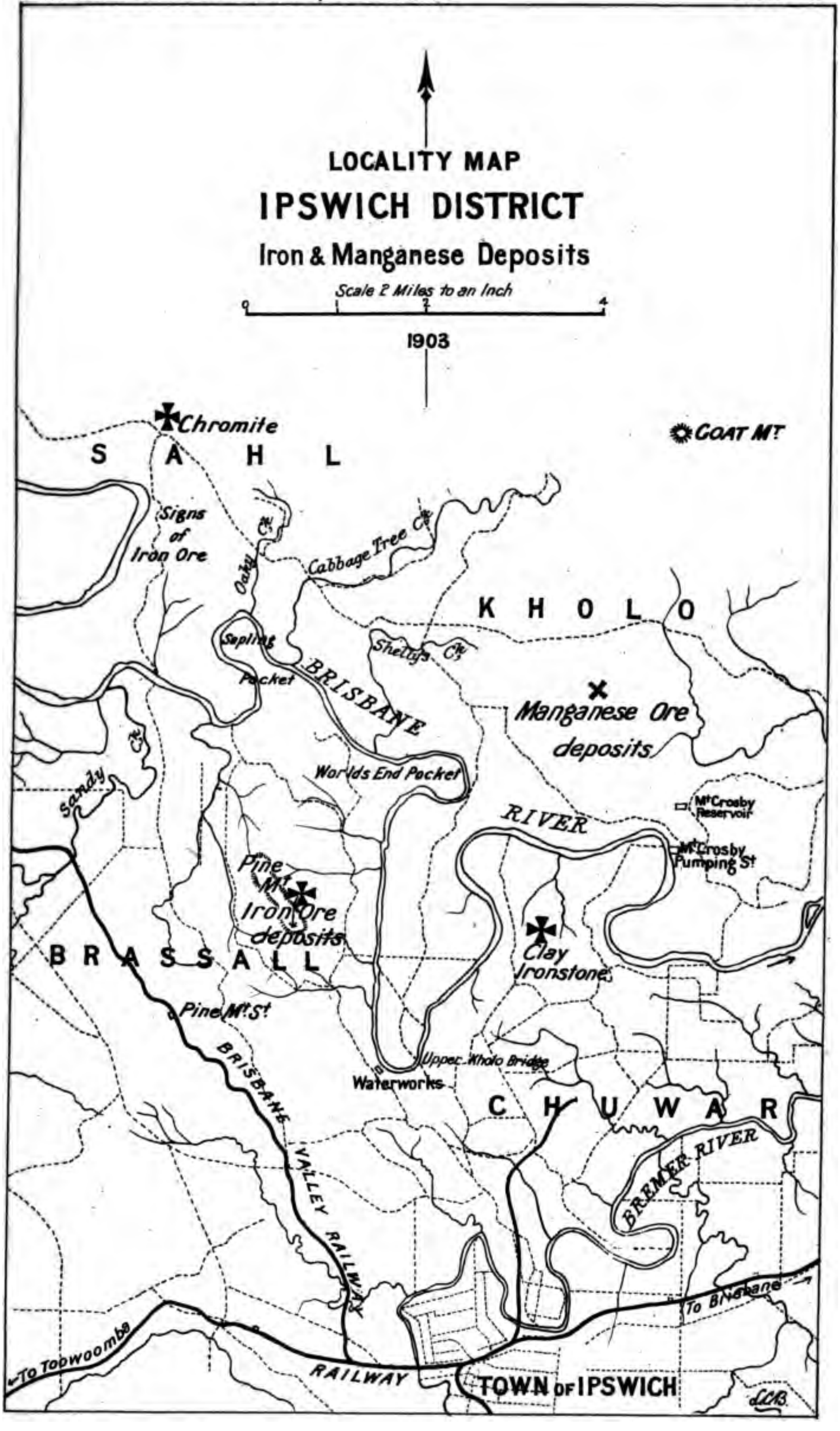
* G.S.Q.P., No. 173.

† Annual Notes. L.C.B. *Queensland Government Mining Journal*, June, 1903, vol. IV.

‡ Report on Yorkey's Gold Field and the Marodian Gold and Copper Field. By L.C.B. Bris. By Auth., 1902. G.S.Q.P., No. 179.

§ Some Manganese Deposits in the Gin Gin, Degilbo, and Warwick Districts. By L.C.B. Bris.: By Auth., 1903. G.S.Q.P., No. 189.

GEOLOGICAL SURVEY OF QUEENSLAND MAP 25



LOCALITY MAP

IPSWICH DISTRICT

Iron & Manganese Deposits

Scale 2 Miles to an Inch

1903

Plate 16.

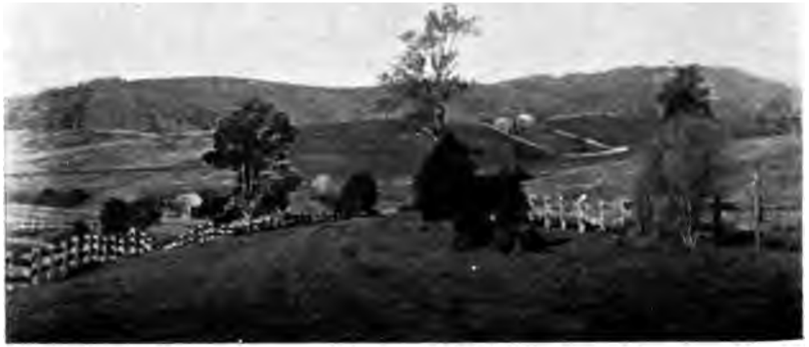


Photo., L C.B.

PINE MOUNTAIN, FROM THE WEST.

(Showing Russel's Workings in paddock in middle distance.)

IV.—IPSWICH DISTRICT.

Locality Map 25.

A—Iron Ore Deposits.

1. PINE MOUNTAIN.

Locality and Topography.—Pine Mountain is a ridge three miles in length in a north and south direction, and at its base a mile in width; the highest point, near the southern end, is five miles north-north-west of the Ipswich Railway Station. (*See* Plate 16.)

It forms a distinctive feature in the landscape, there being no other elevated ground within many miles in all directions. The slopes of the mountain itself are exceedingly precipitous, but the foothills are generally smooth and rounded. The mountain, with the slate country round it, was formerly covered by a dense growth of scrub, patches of which still exist, especially on the north. The scrub growth is due in the first place to the great richness and open nature of the soil, but it has probably been influenced by the water-bearing character of the country rocks.

The mountain owes its existence to belts of quartzite, which have proved more resistant to atmospheric denudation than the ferruginous clay slates, ore bodies, serpentine, &c., round about it.

The term Pine Mountain now includes the closely settled district round the base of the mountain proper. The land was taken up in the very early days, and is now all freehold.

The most striking feature of the district is the redness of the soil on the slate country, the intensity varying from very deep-maroon to light-brown.

Former Reports, &c.—Iron ore has been noticed on the south-west side of the mountain ever since the land was taken up, and several experts from England are reported to have visited the district to inquire into the matter. Mr. William H. Rands, then Assistant Government Geologist, inspected the district is 1894, specially with regard to the discovery of gold and iron ores. The following extracts are taken from his report:—*

"The most westerly bed of the Pine Mountain series is a soft greenish mottled serpentine, which I traced in a north-north-westerly direction from Jackson's selection No. 276 for a distance of about two miles. Lumps of chromite (chrome iron ore). have been picked up on this serpentine area; the greater number of pieces appear to be in the neighbourhood of selections Nos. 536 and 541, taken up in the name of A. W. Knox. I found one piece that must have weighed over half a hundredweight. The chromite has only been found in lumps on the surface, and not *in situ*. From the position of the pieces it is probable that if any regular deposit is found it will be near the summit of the ridge formed by the serpentine (which lies to the west of Pine Mountain proper). Another bed of serpentine, with some impure chrome ore mixed through it, occurs in Gee's selection, about 50 chains due east of the above.

"Immediately east of the serpentine there is a bed of impure brownish limestone. This crops out in Hughes's selections Nos. 306 and 308; in Thompson's selection No. 309; and Hill's selection No. 160A. Further south, in Donnell's and Pennell's selections, the cherty magnesian limestone already referred to occurs. This limestone, I am informed, contains too much magnesia to be of service in the manufacture of cement. Outcrops of this limestone occur in selections Nos. 267, 268, 275, 286, 300, and 301.

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* Annual Report of the Under Secretary for Mines for 1894.

"East of this limestone there is a bed of quartzite stained with oxide of iron; in some places there is such a large percentage of oxide of iron that it becomes a siliceous hæmatite. The outcrop of this bed is 16 chains across in places.

"A drive was put in close to Mr. Russell's house, on selection 312. . . . The drive was about 25 feet in length to the face. The stone was assayed, but found to contain too much silica to be of any use for the manufacture of iron: in fact, the greater part of it was simply an iron-stained quartzite. Some holes have since been sunk by Mr. Russell to the east of Mr. Lloyd Owen's workings, in which he came upon stone with a high percentage of iron in it (a siliceous hæmatite). This richer stone appears to be running in layers parallel to the strike of the beds.

"The same bed of quartzite, with occasionally fair ironstone, can be traced northerly through Brice's selection No. 384, and on, I am informed, across the Brisbane River, and in a southerly direction away to Gee's selection No. 273, and Pennell's selection No. 269.

"Leaving in abeyance altogether the question whether it would be possible to manufacture iron at a price that could compete with the imported metal, there is not stone here suitable for its manufacture in anything like sufficient quantity.

"Another bed of this iron-stained quartzite occurs further to the east, in Scott's selection No. 377."

Prospects.—It is evident from the above that attention has thus far been directed solely to the "quartzite" outcrops, as probably the caps of lodes. While it seems from analogy with the Lake Superior deposits possible that these outcrops will pass into iron ore at a depth, it is also very probable that there are large deposits of ore in the hollows between the outcrops.

In order to test this assumption, rough samples of the surface soil were taken from various localities, but the results of assay were very disappointing.

The following seem to be some of the most likely places for soft ores:—The hollow on the western part of portion 482; the "neck" on the west of Sherlock's Summit; the centre of portion 273; the western side of portions 290, 291, and 292; the western parts of portions 322, 323; portion 319 (?); and centre of portion 379. It may be taken that the average width of these areas will be five chains, and the length from five to 20 chains or more. No definite calculations can be made till the ground has been thoroughly tested, preferably by means of diamond drills.

Owing to the vicinity of the Ipswich coal measures, this locality is all the more worthy of prospecting for iron ores. (What little ore has been found consists of hæmatite.) The Esk Railway passes within a mile of the deposits, and splendid grades could be found for a connecting line, when the total distance from Ipswich would be about seven and a-half miles.

Were steel works erected at Pine Mountain, manganese ore might be brought in small quantities from Kholo, but if that did not suffice, it could be shipped to Brisbane, taken up the river to Ipswich in punts, and then railed to the works.

Pure limstone is the only requisite not found in quantity in the district. Limestone for use in Brisbane has for some years been obtained from the

Duke Islands (between Rockhampton and Mackay), and it might be necessary to bring the flux from there.

Geology.—Pine Mountain is really almost an island in the Ipswich coal measures. No fossils have yet been obtained to give any clue to the age of the rocks. It can only be said that they are much older than the Ipswich coal measures. The youngest rock in the district is the basalt which occurs in patches on all sides of Ipswich. It seems probable that this rock issued from volcanoes or fissures to the south of Ipswich. That now covering an area of two and a-half square miles between Muirlea Station and Pine Mountain seems to have flowed along the western side of the mountain, where fragments only can now be found (portion 293).

The strike of the strata can only be assumed from the outcrops of the quartzite, jasperoid, and serpentine, varying from west-north-west to north-north-west. The dip is nowhere distinguishable except on the river bank in portion 482, where, in one place, it is 40 degrees to the north. It would seem that the strata east of an axis running north-north-east through portion 482, strike nearer east and west (say east-south-east) than the remainder, which strike north-north-west. A reason for the occurrence of the ore deposits is therefore given in that the strata at the bend were shattered, and possibly opened along the bedding, giving circulating waters free passage.

The most western bed exposed, for a distance of a few yards up to 20 chains, consists of a very ferruginous rock, with a skeleton of silica and patches of a green magnesian silicate and veins of opaline chalcedony—probably highly-altered serpentinous rock, as assumed by Mr. Rands. Next to this rock, and sometimes included in it, comes schistose unaltered serpentine, with an average width of a few chains only, but in places up to ten chains.

No extensive beds of limestones were seen, the rock only occurring in small lenses in the slates and jasperoids, the latter rock being probably due to the replacement by silica and iron.

The white magnesian limestone referred to by Mr. Rands is, in my opinion, a secondary deposit, due to the decomposition and leaching out of a former covering of basalt.

The jaseproids are dense, red, flinty rocks, owing their origin chiefly to secondary changes in the original slate or limestone. Partial or complete solution of the original constituents has taken place, and iron and silica have been precipitated in their place. Such a rock is of universal occurrence throughout Queensland in connection with iron and manganese deposits in the older rocks. It is not confined to Queensland being found also with the Lake Superior, United States of America (taconite) deposits, in Cuba, and in Brazil. In many of the Lake Superior deposits the taconite forms a capping over the whole or part of the ore.

The belt of iron-bearing rocks forming Pine Mountain is found to continue north-north-westwards beyond the Brisbane River into the parish of Sahl, where there are most promising indications, on which no work of any kind has been done.

Chromite.—This hitherto undescribed outcrop, on portion 29, Sahl, is 11 miles north-north-west of Ipswich, on the closed part of the old main Brisbane stock route, two chains from the western side of the portion.

The fragments forming the outcrop, and varying from pebbles up to masses of several tons weight, cover an area up to five yards across, extending in a south-south-easterly direction for a distance of two chains. It can reasonably be assumed that there are at least 50 tons of ore on the surface. Ore containing 50 per cent. chromic oxide is worth £5 3s. per ton (April, 1904). The following is the result of analysis (Government Analyst):—

Iron	... ...	13 per cent.
Chromium	... ...	23 ,,

(equivalent to 33.5 per cent. chromic oxide).

The soil here is dark-brown, and at the time of my visit carried thick grass, which rendered geological work very difficult. The only rock-fragments to be found consisted of quartzite, there being no sign of serpentine. Chromite is also found as scattered fragments in the serpentine area between the Pine Mountain school and the mountain itself. These were referred to by Mr. Rands in his report.*

2. NORTH IPSWICH.

Locality.—The property of the Ipswich Coal and Coke Company, portions 178, 179, 184, 123, 126, &c., Chuwar, is at the head of Bundanba Creek, three to four miles north of Ipswich.

Extent.—Ten outcrops of clay ironstone were seen within two miles on a north-east line. As there are a number of faults, the actual number of beds may be less. The tip from Gallen's shaft on portion 123, contains a quantity of ore—a band three feet thick is said to be at a depth of 40 feet.

Clay ironstone is said to form the floor of the Binley (Glencoe) coal seam. The seams are reported to extend for miles. That on 179 and 178 can be followed for a distance of a quarter of a mile. This has a thickness of two feet six inches, and makes a stronger outcrop than the others. The outcrop consists chiefly of limonite.

In calculating the probable quantity available a band of ore (of specific gravity = 4) one foot thick may be taken to contain 12,000 tons per acre.

The proximity of coal is important. A large seam with bands runs through the centre of the property, only a few chains from the largest of the clay iron outcrops. Coal has been worked to some extent in the Glencoe and Boxwood Collieries.

These bands would be worked in conjunction with the coal, and would be roasted and smelted on the ground.

Upper Kholo Bridge, on Brisbane River. Samples of limonite have been brought in from this locality, but the occurrence has not yet been inspected.

In connection with the above the occurrence of clay ironstone at Slack's Creek, 16 miles south-east of Brisbane, and also on the Burrum Coal Field, should be mentioned.

3. PARISH OF DUNDAS.

Locality.—Portion 140, Dixon (and 33, Dundas), 13 miles east of Esk. Portion 140 is in broken country at the head of Middle Creek, but portion 33 is in comparatively gentle country. It is believed that the road down Middle Creek to Bellevue Railway Station is very gentle. The distance is about 18 miles. Esk is nearer, but part of the country to be traversed in that direction is rather broken.

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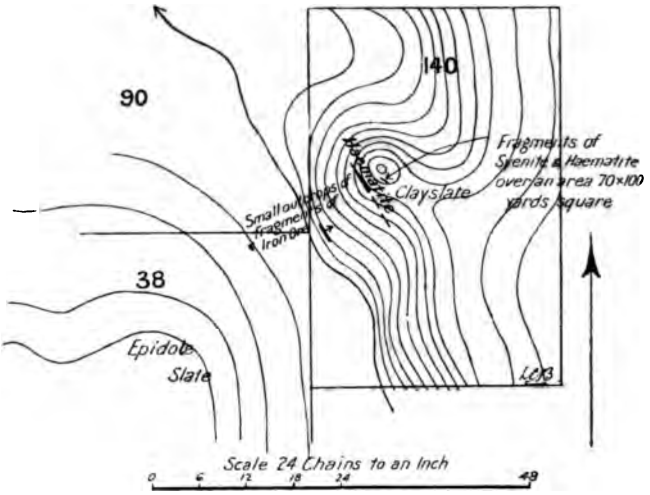
* *Op. cit.*

Fig.7.


90
140
38
Small outcrops of fragments of Iron Ore
Haematite
Clayslate
Fragments of Syenite & Haematite over an area 70×100 yards square
Epidote Slate
LCB
Scale 24 Chains to an Inch
0
6
12
18
24
48

Extent.—The main deposit is 18 inches thick, extending for only a few yards, ten at most, with well-defined walls, but sometimes including country rock. Fragments of ore are found on the hill above, on the north-east, covering an area 70 by 100 yards, and down the hillside on the south-west to Middle Creek. They have probably been shed from small lenticular bunches.

Ore.—The ore is massive crystalline hæmatite of great purity. It is strongly magnetic.

Country.—Clay slate, striking north-west and dipping north-east, and dykes of syenite. A large outcrop of granitic syenite occurs on portion 90, about one mile north-west from the iron ore. The ore probably owes its origin to a continuation of this mass under portion 190. The deposit is mentioned because an exaggerated idea of its size has been formed by many. There probably are other deposits in the locality, but no prospecting has been done for iron.

4. PARISH OF DUGANDAN.

Locality.—Parish of Dugandan, pre-emptive purchase 1. On the chain-road, about three-quarters of a mile north of the Dugandan Bridge over Teviot Brook, 2½ miles east-north-east of Boonah, which is 59 miles distant from Brisbane by rail.

Extent.—Two outcrops of clay ironstone (each six inches to a foot thick, weathering red with cracks filled with calcite), dipping at an angle of 45 degrees north-west, are separated by about 40 feet of shaly sandstone containing petrified trees preserved in limonite. A dark band (probably a coal seam) under sandstone occurs about six feet above the clay ironstone. Numerous (half a dozen) beds besides these are to be seen on the main northern road from Dugandan Railway Station, a mile to the west of the above-mentioned outcrops. They do not extend to the east because of the intrusion of the trachyte (?) mass forming Mount Dugandan.

A sample from the large seam on pre-emptive purchase 1 yields (Government Analyst):—

Iron	... ...	45.36 per cent.
Silica	... ...	12.4 „
Phosphorus ...	...	0.234 „
Sulphur	... ...	Nil.
Carbon dioxide	...	4.4 „

Some little work would have to be done on these deposits to show whether they are thick enough to be worked. It is, however, highly improbable that such ore could be worked even if, as people in the district report, almost every well sunk has passed through one or more coal seams of medium thickness—two or three feet.

5. PARISH OF COOCHIN.

Various outcrops of clay ironstone are seen on the road running south from Dugandan to Coochin Head Station.

(*a*) Boulders one mile north of the Wallace Creek Crossing.

(*b*) Outcrop on the road between portions 104 and 46N. There are also signs of two seams of coal within a quarter of a mile to the north-west.

B—Limestones.

1. PINE MOUNTAIN.

The only bedded limestones known in the Ipswich district are the small deposits near Pine Mountain, but magnesites, passing into dolomite, and even into limestone, occur as secondary products, due to the decomposition and leaching out of the basalt caps found at numerous places.

2. IPSWICH.

The limestone on Limestone Hill, which was formerly used locally for making cement, was proved by Mr. Maitland, a former Assistant Government Geologist, to be the cap of an igneous dyke.*. The quantity available for any purpose is not large.

C—Manganese Ore Deposits.

1. PARISH OF KHOLO.

INTRODUCTION.

The deposits visited are in the southern part of the parish of Kholo, from six to nine miles north of Ipswich, and all within three miles of the Brisbane River. Besides those shown on the map, others are reported to be in the broken country in the far north of the parish, and still others occur near the Moggil parish boundary, a few miles to the east.

Serious mining operations have been undertaken at only one place—viz., Dandy's Knob, on the reserve for water supply, but trenches and potholes have

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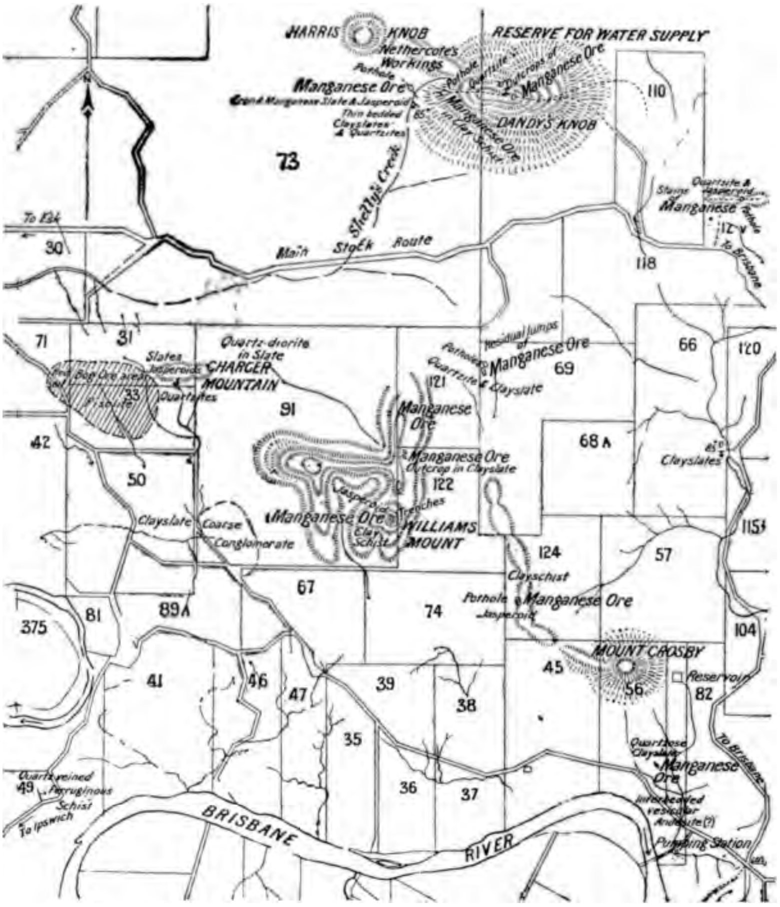
* Ann. Prog. Rep. of William H. Rands, Assistant Government Geologist, for the year 1894.

GEOLOGICAL SURVEY OF QUEENSLAND. MAP 26.

MANGANESE ORE DEPOSITS,

PARISH OF KHOLO.

Scale: ¾-mile to an inch.



L. C. Ball.

been opened on portions 91, 56, 24, 69, 73, and 12v. The manganese occurs in bunches generally containing only a few tons of ore, and operations have in these cases been suspended as soon as the bunches cut out. Portions 56, 69, 122, and 91 have been leased by the owner for manganese mining for a term of twenty years for a royalty of 1s. 6d. per ton raised.

The distribution of the outcrops over an area of six square miles gives promise of permanency. Larger deposits may yet be found, and the comparative purity of the ore is some inducement to prospect. At present, however, nothing is being done in the district. The value of the occurrences lies chiefly in their proximity to the Ipswich coal and iron deposits.

The Kholo manganese ore, as a whole, is freer from clay than that at Gladstone, and when pure, a much larger proportion of it is soft, most of the harder material being only partly replaced slate. The deposits occur in at least four distinct zones or horizons. The country rocks (clay slate and schist, quartzite and red jasperoid), are very similar in general characteristics to those at Gladstone, though more thinly laminated in the Kholo district. Their age has not yet been determined (though shown on the State map as Gympie, Permo-Carboniferous).

DANDY'S KNOB.

Locality.—This mountain lies just outside the eastern boundary of portion 73, half a mile north of the main stock route, and at the junction of the ranges separating the waters of Cabbage-tree, Shelly, and Cameron's Creeks. It rises some 300 feet above the stock route, and 500 feet above the river.

Workings.—Manganese-bearing clay slates and jasperoids have been trenched for a distance of two chains. The main opening in clay slate and jasperoid (dipping 70 degrees north a few degrees east), from which a small bunch of ore has been removed, is ten chains east of portion 73. A shaft has been sunk 80 feet in clay schist 20 feet north of this. At the time of my visit it was open only to the 30-feet level, where there is a crosscut to the lode ten feet in length. This appears to have met a bunch of ore six feet long and up to a foot in thickness. Practically all the ore was removed, so that no idea can be formed as to its quality; the adjacent country is quartzite.

It might have been worth while crosscutting 15 or 20 feet further to reach the manganese-bearing stratum exposed in the hole south of the main open cut. The stratum consists of three feet of clay slate and jasperoid, partly replaced, and veined with manganese dioxide, and is very likely to improve in depth.

A mistake was made in sinking the shaft away from the lode, because of the bunchy occurrence of the ore. Had the shaft been sunk on the lode, any small bunches of ore struck would have helped pay expenses, and much more prospecting could have been done.

Between 70 and 100 tons are reported to have been shipped from this place, but no records are available.

PORTION 91.

Williams' Hill, on the eastern side of freehold portion 91, about 15 chains from the southern boundary, rises 300 feet above the Brisbane River.

An outcrop of jasperoid clay slate, partly replaced by manganese ore, and varying in width from two to four feet, can be traced in a north-westerly direction across the hilltop for a distance of a chain from the eastern boundary. Two small bunches of ore, ten yards apart, have been opened, yielding a total of only two or three tons of marketable ore. This ore assays (Government Analyst):—

Iron	0.56	per cent.
Silica	17.7	„
Manganese	42.7*	„
Phosphorus	0.13	„
Sulphur	Nil.	

The immediate country is clay schist, except at the northern end, where reddish jasperoid forms the footwall.

PORTION 56.

There is on this freehold a small outcrop on the end of a spur, five chains north of the river road and 25 chains north-north-west of the Mount Crosby Pumping Station. A trench ten feet long and six feet wide, has been opened to a depth of five feet on a body of ore which appears to dip 45 degrees to the south-west. The ore has a slaty glassy appearance, and altogether about ten tons have been obtained. It assays (Government Analyst):—

Iron	0.67	per cent.
Silica	27.6	„
Manganese	42.4	„

The country rock is quartzose clay slate.

PORTION 124.

On the western slope of a razorback running from Mount Crosby along the western side of this freehold is an outcrop of manganese ore, 300 feet above the river. The surface soil has been scratched away, but really no work has been done, and little can be seen of the deposit. The ore body appears to be two feet thick, and to strike north-west. South of it is jasperoid, and north is clay schist. It is worth testing.

PORTION 69.

Two patches of about a ton each of residual blocks of good ore have been found in the north-western corner of this freehold. The country is quartzite and clay slate, and beyond the blocks mentioned there is no sign of ore. Further prospecting in the locality would, however, no doubt lead to additional discoveries.

PORTION 122.

In the north-western corner of this freehold similar lumps of good ore are found, but amount to only a few hundredweight. They indicate the general manganiferous nature of the locality.

PORTION 73.

There are two outcrops on this freehold. The first, on the line of the Dandy's Knob lode, is about 20 chains west of the main shaft there, and consists of two to three feet of clayey schist and manganese ore. A shaft was, without result, sunk ten feet on this, in the reasonable hope that there might be a bunch of ore beneath, the surface material being quite unmarketable.

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* Equivalent to Manganese dioxide .. 64·8 per cent.

The second outcrop is five chains further west, and is only about 150 feet above the river. A trench was opened in four feet of red clay soil, with residual lumps of siliceous ore, on quartzite partly replaced by and containing bunches up to three feet thick, of poor slaty ore. There is very little marketable ore, but it may, as elsewhere improve at a depth.

In the creek below the last deposit is a ten-feet band of ferruginous and manganiferous slate which, owing to the proximity of quartzite and jasperoid, is worth following and prospecting for bunches of manganese ore. The occurrence of a permanent spring here gives further promise of there being ore deposits on this line.

PORTION 12V.

Manganese-stained quartzite and jasperoid, five chains north of the main stock route, have been prospected at several points in portion 12v, but it seems to have been labour wasted.

PORTIONS 31, 32, AND 71.

Included partly within each of these freeholds is an area 18 chains in length and 12 chains in greatest width, consisting of flat red soil country, which is believed to be underlaid by bog iron-manganese ore. The only place where the underlying rock can be actually seen is in a small cañon-like creek running south, through portion 32, from the boundary of portion 31. Here it is coarsely pisolitic bog ore. Near its head the creek has exposed five feet of ore, in which, judging from its appearance, manganese is in excess of the other constituents. Iron and alumina gradually increase for a few chains towards the south, but about ten chains down the manganese again predominates. The pisolitic structure is much more pronounced where the manganese is most plentiful, the rock having a brecciated appearance when it is absent. Where the creek passes out of the pisolite on to the clay slates it has cut down into the former to a depth of 20 feet. A rough sample from the whole length of the creek contained (Government Analyst):—

Iron	11.58	per cent.
Aluminium ...	5.25	,,
Manganese	7.17	,,

Boring would be necessary before any exact or even approximate determination of the amount of ore present could be made; but taking the average as one-third the greatest thickness (say, six feet), and the area as 15 acres, there will be, roughly, 145,000 cubic yards, equal to 360,000 tons of ore in the deposit.

With regard to the origin of the above, there must formerly have been covering the area a swamp which received part of the drainage from the Charger Mountain ridge on the north. This ridge is built up of quartzites, slates, and jasperoids, with evident traces of manganese ore. The iron and manganese would be dissolved as carbonates, and precipitated in the bog as oxides.

According to its composition the ore will be a wad (manganese dioxide), limonite (hydrated iron sesquioxide), or beauxite (hydrated alumina). The first, if containing more than 40 per cent. manganese, would be of value in steel-making, the second as an iron ore, and the third for the manufacture of aluminium, alums, and as a refractory material for furnaces.

V.—DARLING DOWNS DISTRICT.

A—Iron Ore Deposits.

1. PITTSWORTH.

Deposits in Basalt Area.

PORTION 1847, RIVERSTON.

The ore deposits are in the south-eastern corner of the portion, three miles north-east of the Pittsworth Railway Station. (*See* Locality Plan 27.)

The outcrops, consisting of scattered blocks of variously hydrated oxide of iron, occur on the crests and slopes of low basaltic ridges. Only two or three potholes have been opened on the deposits, and, owing to their dilapidated condition, little can now be learnt from them.

(*a*) The first "blow" is on the southern side of the portion, about ten chains from the western boundary. It consists chiefly of boulders of massive brown limonite ($Fe_2O_3.1\frac{1}{2}H_2O$—hydrated oxide of iron), sometimes showing a structure resembling that of decomposing basalt, with a little yellow gothite ($Fe_2O_3.H_2O$). The area covered is about a chain in diameter, and assuming a thickness of one foot, it contains less than 100 tons of ore. Pebbles of ore also occur scattered over the surface for several chains to the west. The deposit is surrounded by basalt, and probably rests on the same rock.

(*b*) The next outcrop is five chains to the east. It is only five yards in diameter, and consists in greater part of decomposed basalt. Unweathered basalt lies all round it.

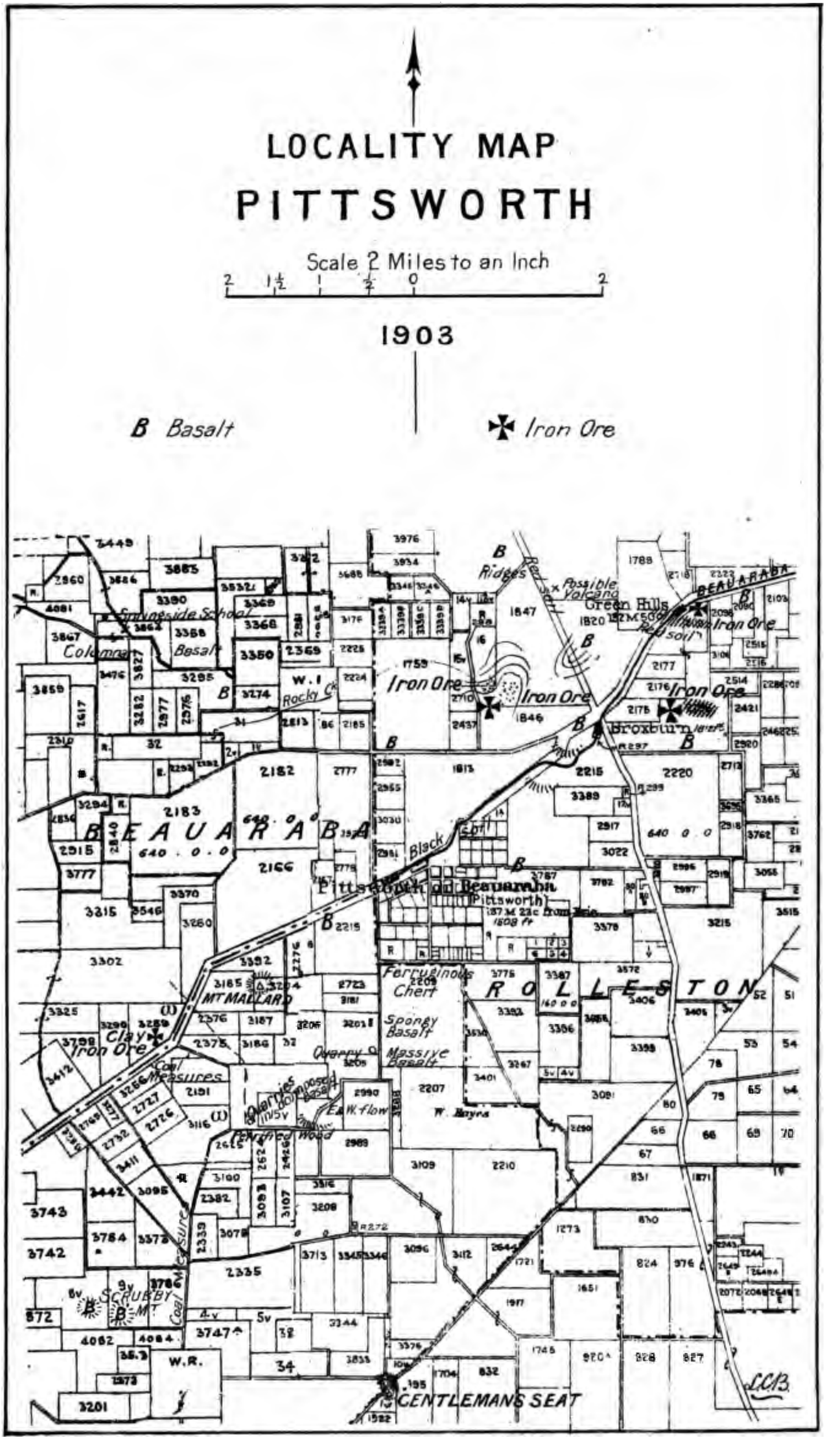
(*c*) The third outcrop is 20 chains from the western boundary. It is five chains in length in a north and south direction, and its width increases from a quarter of a chain at the hilltop on the south to five chains on the slope to the north, the total difference in elevation being about 50 feet.

The ore consists chiefly of light-brown gothite, with a smaller amount of dark-brown limonite and reddish-brown turgite ($Fe_2O_3.\frac{1}{2}H_2O$), the conchoidally weathering limonite occurring chiefly towards the western side of the outcrop, and abutting directly against undecomposed basalt.

Near the hilltop a shaft was sunk to a depth of 13 feet, but it is now filled in below eight feet. It proves that the iron ore at that point forms a capping from one to three feet thick, and that it decreases in quality with distance from the surface. Below the iron ore is soapy kaolin (decomposed basalt or volcanic mud?) variously stained with iron oxides.

The spur running north-east from the pothole is capped for five chains with turgite and limonite (one to three feet thick, in a trench near the centre), and in the lower portion the ore spreads out over a width of four chains. The thickness may in places be ten or 20 feet, but it is more probably generally less than three feet. The solid, reddish, earthy ore along the ridgetop gradually becomes more and more hydrated down the flanks.

GEOLOGICAL SURVEY OF QUEENSLAND **MAP 27**



LOCALITY MAP

PITTSWORTH

Scale 2 Miles to an Inch

1903

B Basalt

✠ Iron Ore

Taking the average thickness as two feet (no more than which has been proved), the amount of ore present is about 10,000 tons, and the general sample from the whole of the outcrop yields (Government Analyst):—

Iron	49.9	per cent.
Titanium	Nil	
Silica and insoluble...	10.1	„
Phosphorus	0.34	„
Sulphur	trace	

The basalt above and to the south-west of the pothole seems to be columnar, and occurs in small ridges, which have a striking resemblance to lava flows. Small pieces of magnetite are found scattered over this country.

(*d*) A fourth outcrop lies across the gully to the north-north-west of the above. A pothole opened ten chains north of the south-eastern corner of 16v is three feet deep, and still in solid limonite. The ore is less pure than that to the south; it contains a larger amount of both water and clay, and, besides, the outcrop is not so well defined. North of the pothole scattered pebbles are found for a quarter of a mile.

(*e*) Solid earthy mammilated and concretionary turgite and limonite outcrop on the boundary of 1847 and 16v, three chains east of the road on the western side of the portions, with basalt on both sides and above or to the south. The outcrop is between three and four chains long, and is one and a-half chains wide. Assuming a thickness of one foot, the amount of ore present may be taken as 3,000 tons.

PORTION 2110, ROLLESTON.

Lumps and pebbles of earthy turgite and limonite occur in a belt of red soil, which crosses portion 2110, Rolleston, and the Pittsworth Railway Line, a few chains west of Green Hills Railway Station. It is said that solid ore can be reached at a depth of two feet anywhere on the ridge. At one place on the road, a quarter of a mile from the railway line, blocks of ore lie scattered over an area five chains across. A large specimen of the ore was obtained, and is now on exhibition in the Geological Survey Museum.

PORTION 2188, ROLLESTON.

On portion 2188, ten chains to the south-west of portion 2514, and one mile south-south-east of the Green Hills Railway Station, is another outcrop, five chains in diameter, with a narrow tongue running south for several chains. Large blocks of ore—gothite, limonite, and turgite (in small amount)—lie partly buried in the red soil. The limonite is the hardest, and the others seem to have been derived from it. Its fracture is often conchoidal, and its appearance is sometimes almost glassy, but the softer parts are minutely honeycombed. On the whole the ore here seems to be less altered than on portion 1847.

No data can be obtained as to the thickness of the deposit, but the amount of ore may be taken as 1,000 tons for each foot in depth. The sample from the whole surface contains (Government Analyst):—

Iron	52.3	per cent.
Titanium	Nil.	
Silica and insoluble...	8.9	„
Phosphorus	0.2	„
Sulphur	trace	

Undecomposed basalt outcrops on the north and north-east, and kaolinised basalt forms dark soil on the other side of the deposit.

Origin of the Ores.

Mr. Jaquet, in his memoir on the iron ores of New South Wales,* refers to ore similar to the above, but light-brown in colour and vesicular in texture, as "basaltic iron ore." He believes that they have been derived by weathering from basalt, and gives the following analyses:—

		LIMONITE.		BASALT.
Fe_2O_3	...	48.16 per cent.	(metallic iron 30.21 per cent.)	3.86 per cent.
SiO_2	...	33.04 ,,	... ...	41.15 ,,
P_2O_5	..	0.54 ,,	... ..	0.27 ,,

The ore—always low in iron, and high in silica and other impurities—invariably rests on basalt, generally in swampy places, and forms a crust from a few inches to several feet thick, sometimes over several acres. Beneath the ore lie variously-coloured clays with scattered lumps of ore.

The undecomposed state of the basalt surrounding the Pittsworth iron ores, and the fact that the deposits are sometimes on ridgetops, are rather against the application of the theory here. The evidence on the field certainly pointed to the ore having been derived from a volcanic rock, but more probably a volcanic mud than a lava, flows of the former having quite possibly taken place at the end of the volcanic period.

Deposits in Coal Measures.

Beds of clay ironstone (impure carbonate and hydrated oxide of iron) occur in the coal measures west and south-west of Pittsworth.

An outcrop can be seen on the main Yandilla road (between portions 4084 and 3786, North Branch), three miles west-south-west of the railway terminus. The bed is about 12 inches thick, dips apparently 70 degrees to the west-north-west, and is included in calcareous sandstone.

Similar calcareous sandstone and clay ironstone, together with wood petrified by turgite and calcite, ocurs on the branch road leading up to Scrubby Mountain, five and a-half miles south-south-west of the railway terminus, but there is no actual solid outcrop.

These deposits may not be of any account in themselves, but they are most important in showing the existence of clay iron ore in the coal measures. Coal seams have been proved in numerous wells in various parts of the district, and it may prove possible in the future to work the coal and iron ore at the same time. It will thus be necessary, when boring operations for coal are undertaken, to keep an account of all iron ores passed through, and the hope may be entertained that much more important beds than those now known will be found.

Limestone flux seems to be the only thing wanting in the district for the reduction of the ore, and this will have to be procured, even though a certain proportion of the ore proves to be self-fluxing.

CONCLUSION.

Freight.—Pittsworth is 137 miles distant by rail from Brisbane, the nearest seaport. It is doubtful whether any ore for iron making could be profitably sent such a distance with our present freights (11s. 8d. per ton); but there is no doubt that ore of the quality found at Pittsworth could not bear the expense. Therefore, the only alternative would be to smelt the ore in the locality, and for this both fuel and flux are required.

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* "Iron Ores of New South Wales." By J. B. Jaquet, A.R.S.M., F.G.S., Geological Surveyor. Sydney: By Auth., 1901.

Flux.—The nearest limestone on the railway is at Silverwood, 73 miles distant, and the freight would thus be a very heavy item.

Fuel.—There would probably be no difficulty in obtaining supplies of coking coal by sinking even in the immediate vicinity of the ore deposits, as thin seams of coal have been proved in several wells within a few miles distance, and the coal measures are known to pass under the basalt. I have not seen any of the seams, but specimens of highly gaseous coal were obtained from the mullock tip of the Government well, four miles south-west of the Pittsworth terminus. This coked only very slightly, but that may be due to long exposure. Several seams, one three feet thick, within a depth of 160 feet, are reported to have been cut in the Divisional Board well at St. Helens, eight miles west of Pittsworth, and another three-feet seam is said to have been struck at 40 feet depth in a well two miles west of the ore deposits. The beds are of the same age, and similar in character to those at Ipswich. It may, therefore, be taken that if sufficient ore could be found the fuel to smelt it would not be wanting.

Unfortunately, there seems to be no probability of the deposits in the basalt area extending for more than a few feet below the surface, and it is thus evident that only a few thousand tons of medium quality ore high in phosphorus can be depended on. The only likelihood, therefore, of the deposits ever being worked is in the event of the clay iron ores of the coal measures proving extensive. Then, should ironworks be established locally, all available ores will receive attention.

The Pittsworth ores, owing to their softness, vivid colouring, and comparative purity, should be of some use for the manufacture of pigments.

For the present the clay iron ores are not likely to be worked, because large quantities of far purer ore are found in much more convenient positions, but there is no doubt that at some time in the future they will be exploited.

2. WARWICK.

Only brief reference is here necessary to the occurrence of very similar limonite with laterite on Mount Sturt, in the Warwick district. The amount seen was inconsiderable, but no special search has yet been made there for the ore. The more ferruginous parts of the laterite here would probably be of value for the manufacture of pigments, the rock being soft, as a rule, vividly coloured, and in large quantities, within a few miles of the railway line.

3. TEXAS.

Reference to the occurrence of small bodies of limonite and magnetite with limestones will be found under the description of the Silver Spur Mine, in a separate report.*

B—Limestones.

1. SILVERWOOD.

Reference has already been made to the limestones near the Southern Railway Line, at Silverwood, nine miles south of Warwick. The deposits have not been inspected, but they are believed to be now being quarried, and the limestone is known to be of good quality.

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* Notes on Tin, Copper, and Silver Mining in the Stanthorpe District. By L.C.B. Bris.: By Auth., 1904. G.S.Q.P., No. 191.

C—Manganese Ore Deposits.

1. WARWICK.

(*a*) Parish of Rosenthal.

On portions 95v, 96v, and 3v, Rosenthal, six miles south-west of Warwick, are three lines of manganese outcrops, five chains apart. The country rock is slate and quartzite, which have been intruded within a few chains to the west by granite, and which a similar distance to the east are overlaid by sandstones and conglomerates, of Ipswich age.

The main outcrops are on portion 95v, and really consist of little more than slates and quartzites, stained and impregnated by psilomelane (dioxide) and rhodonite (silicate), though there is some reason for believing them to be on lines of fracture. The western deposit is two feet wide; the central is one foot wide on surface, but increases in quality and width with depth. The eastern at northernmost outcrop is eight feet wide, but consists in greater part only of partly replaced slate.

The deposits might receive attention were steel-works to be erected in the district, but there seems very little probability otherwise.

(*b*) Mount Gammie.

The deposit on this mountain, which lies 22 miles west by north of Warwick, as thus far opened up, has proved insignificant. It is mentioned because of the probability of an improvement taking place in depth, and a description will be found in a previous report.*

---

* Some Manganese Deposits in the Gin Gin, Degilbo, and Warwick Districts. By L.C.B. Bris.: By Auth., 1904. G.S.Q.P., No. 189.

4th May, 1904.

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LETTER OF TRANSMITTAL.

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Queensland Geological Survey Office,
Brisbane, 13th March, 1904.

SIR,—I have the honour to forward for publication Mr. Ball's "Notes on Tin, Copper, and Silver Mining in the Stanthorpe District."

A short visit of inspection was made by Mr. Ball at the end of 1903, and the notes he has compiled bring up to date all the information concerning mining developments in that part of the State.

The notes embrace—

(1) A general review of tin-mining at Stanthorpe, including a description of ground-sluicing, dredging, and lode-tin mining;

(2) An account of recent developements at the Sundown Copper and Tin Mines, at the Silver Queen Mine, Severn River, and at the Pikedale Silver Mines; and

(3) A description of the silver and copper mines in the neighbourhood of Texas.

I have, &c.,
B. DUNSTAN,
Acting Government Geologist.

To the Under Secretary for Mines.

589771

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NOTES ON TIN, COPPER, AND SILVER MINING IN THE STANTHORPE DISTRICT.

(WITH THIRTEEN PLATES.)

◆

I.—Notes on Tin Mining in the Stanthorpe District.

The tin-mining industry in the Stanthorpe district has always depended on the alluvial, none of the lodes hitherto discovered having proved either rich enough or permanent enough for exploitation. Very little can be added to what Mr. Skertchley has said in his report* on the district with regard to the ordinary primitive methods of saving the tin; but since that report was written dredging has been introduced, and should prove in numerous cases a pronounced success. It is my opinion, and that of experienced tin-mining engineers from other States, that there is a bright future before Stanthorpe, but that capital and modern appliances for the economical treatment of large quantities of material are necessary in order that the tin ore still in the "wash" may be saved.

I.—PAN-WASHING AND CRADLING.

Pan-washing and cradling have now practically gone out of use in favour of box and ground sluicing. Just at the time of my visit (November-December) there were very few men on the alluvial, even the ordinary average having been reduced owing to the swollen state of the creeks, due to late rains. There are believed to be about 100 alluvial men in the district, but I think that greatly in excess of the number. Most of the work done by these men is working over the old alluvial, sometimes for the third time; but some of the creek beds are found to be worth attending to after every flood.

II.—GROUND SLUICING.

(*a*) SUGARLOAF CREEK.

Most of the tinstone now being got is from the Sugarloaf Creek district, and the greater part of that is brought in by Chinese. Part of the old Brisbane claim has been subleased to one of them, who employs ten men, and has done a large amount of work—turning over old tailings chiefly. A large stream of water is brought in a race from a point on Sugarloaf Creek, 2½ miles distant, and by its aid the old tailings, to a depth of 10 feet, are sluiced down. On the bottom is a bed of "cement," 2 to 4 feet thick, which the Chinamen do not attempt to penetrate, though it is believed that wash exists underneath it. The great difficulty in ground sluicing is the liability to failure of the water supply, droughts, even in this district, causing stoppages for several months in the year.

No information could be obtained from the gentleman in charge, because of the want of an interpreter. It is considered that five sluicers should put through 20 cubic yards a day, so that ground carrying 4 lb. of tinstone per yard would yield a profit of 9s. 9d. per man, with tinstone at 68s. per cwt., the present (December) local price. The ground worked by the Chinamen contains probably less than 2 lb. per yard.

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* G.S.Q. Publication, No. 120. Geology of country round Stanthorpe and Warwick, with especial reference to the Tin and Gold Fields and the Silver Deposits. By Sydney B. J. Skertchley, late Assistant Government Geologist. Brisbane: By Authority. 1898.

(b) Severn River.

Locality.—During the last few months Prospecting Areas 47 and 48 have been pegged out on the Severn River, 6 miles west of Ballandean Railway Station, and 14 miles south-west of Stanthorpe. P. A. 48 includes a flat-topped ridge, 10 chains wide, running parallel to and on the left side of the river, and rising 60 feet above it. P. A. 47 is in the gully to the west of the ridge. In addition to the above, the company holds a 20-acre water area, which takes in a waterhole 20 feet deep, 1 chain wide, and 10 chains long, adjacent to P. A. 48.

Geology.—The occurrence of rich residual surface tinstone here is mentioned by Mr. Skertchley*, and is shown on his map, so that this is not a new discovery, but simply an attempt to work ground not hitherto considered payable.

The country rock on the claims consists of granite and greisen (with north-north-west master-joints), exposed by denudation of the overlying slates, but as yet very little eroded themselves—that is to say, the rock exposed is the uppermost portion of the intrusive mass. A large part of the granite has been greisenised, owing, as Mr. Skertchley explains, to the spreading out at the base of the slates of the " greisenising liquids " (or, more properly, the pneumatolitic solutions) from the granite. In one place on P. A. 48 the greisen forms a large outcrop, and several trenches have been cut on it. A shaft was sunk 30 feet in it, coarse tin being found in places, with a little wolfram and molybdenite, and also a few patches of mispickel. A number of trenches have been cut, and some of the heaps beside them yield as much as ¼ oz. of coarse tinstone (crystals up to ½ inch in diameter) to the dish. Two tons of tin are reported to have been obtained from this locality—apparently from rich but scattered bunches.

Mr. Baker, who is in charge of operations, expects that 30 acres of the ground will average from 2 to 4 feet of soil, yielding 4 lb. of tinstone to the yard. The whole thing depends on the testing of the ground, which requires a large number of holes.

Plant.—Water will be raised from the waterhole to the highest point on the ground by a 16,000-gallon Knowles duplex pump, which has been erected on a rocky platform 10 feet above the ordinary level of the water, but below flood level, and is to be served with steam from a Pennsylvania marine-type multitubular 12-horsepower boiler, situated 25 feet above the water and clear of floods. The water will be forced from the pump through 6-inch flanged galvanised iron Zollner pipes, which are made in 18-feet lengths, weighing 50 lb. each, and specially suitable for transport to such inaccessible places as this. They have been tested to 200 lb. pressure, so that it will be possible, if future operations show it to be advisable, to undertake hydraluicing with the present plant.

The method of working will consist in having five or six main races radiating from the topmost point; into them the soil from the intervening ground will be sluiced, the soil being washed down into the river and the tinstone left behind.

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* *Op. cit.*, p. 48.

Plate 1.

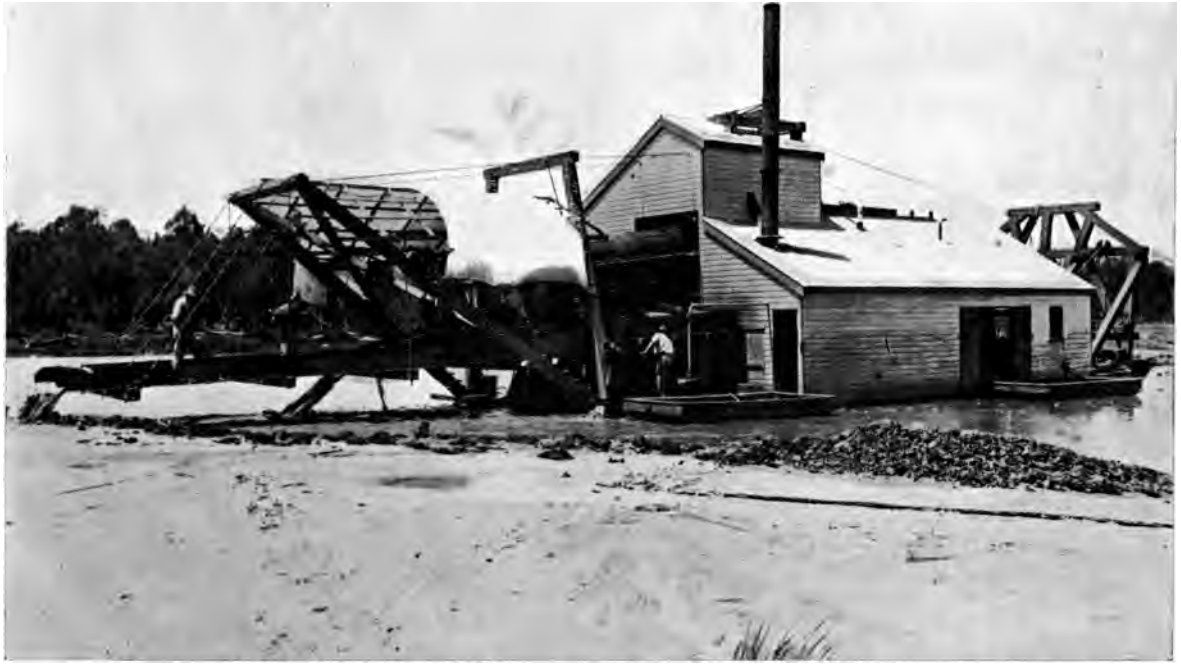


Photo., L.C.B.

WYLIE CREEK DREDGER, N.S.W.

SHOWING REVOLVING TROMMEL, SLUICE BOXES, AND LONG TOM.

Great trouble was experienced in getting the machinery on to the ground, owing to the road from the railway reaching only to Ballandean head station; beyond this a track had to be cut across a precipitous range, which might have been escaped, and the river bed followed, but for the floods just then prevalent.

III.—DREDGERS.

There are two dredges in the Stanthorpe district, in Queensland, and one in the continuation of the same country in New South Wales. Owing to the late drought they were able to do nothing till the middle of last year. That in New South Wales is now on a dividend-paying basis, and a description of it is given below for comparison with the Queensland dredgers, one of which is now in a fair way to successfully work its ground. I have to acknowledge the great assistance rendered me in each case by the manager.

(*a*) New Wylie Creek Dredging Company

(Mr. Bryce, manager).

The New Wylie Creek Dredging Company has a nominal capital of £31,000, of which £29,000 has been allotted in 10s. shares. Three leases, amounting to nearly 200 acres, are held from the Crown.

Locality.—Wylie Creek is a tributary of Harding Creek, which flows into the Clarence River.

The present dredger is 3½ miles below Wilson's Downfall, on the Stanthorpe-Tenterfield road, 5½ miles from the Queensland border, and 15 miles by road from Stanthorpe. It lies on a large 27-acre flat (practically all worked over by the earlier miners), near the lower end of the leases. The creek for miles below this has been worked by miners, but it is not considered dredgable. On account of the success of the first dredger a proposal is now being considered to erect another about half a mile up stream, where the ground, being too deep for the miners, is expected to be richer than the old tailings.

Ground.—According to the borings, which were made in rows 10 chains apart, the ground should carry 2 lb. of tinstone per yard, but the dredger during the last half-year saved only ¾ lb. per yard, and as the manager believes he saves 75 per cent. of the tin ore put through the dredger, the total in the wash cannot be more than 1 lb. Just at present slightly better results are being obtained, but it is probable that the dredger will be turned, and its tailings put through as a test. The ground which thus far has given best results is what was too poor for the miners, and consequently untouched by them.

The average depth of the ground is 14 or 15 feet over the whole of the dredgable portion, and the average width is 7 to 8 chains. The bottom is a soft decomposed granite. Little trouble is experienced with boulders, only one bank of them having yet been encountered; and, just at present (November), the dredger is passing through fine drift sand.

Dredger.—The new Wylie Creek dredger was finished by the end of 1901, but, owing to the drought, a start could not be made till March, 1903, and then the water to float it had to be pumped into the paddock for a month or two. Till June only one shift of men (working eight hours a day) was employed, in August a second was put on, and now three shifts are working.

The dredger is of the ladder-bucket form, and cost between £6,000 and £7,000. The pontoon is 40 feet in length by 20 feet across (dimensions approximate), and owing to its comparative shortness, the heavy sluice boxes at the stern cause that end to sink a couple of feet deeper than the bows, even though numerous large half-ton boulders dredged up are used as ballast. The machinery (including the buckets, winches, and pumps) was supplied by the Clyde Engineering Works, and is all driven by a 12-horsepower compound engine.

There are 27 buckets, of 4 cubic feet capacity, provided with tire-steel lips, and spaced 4-feet centres, and the ladder allows dredging to a depth of 20 feet. The material raised by the buckets should be thrown on to a manganese steel "dropshoot," but while in shallow ground the buckets do not pass within 6 inches of the shoot, and then much of the wash (often half a bucket) misses the shoot and falls down the well into the paddock again. This represents a serious waste, so that an easily adjustable shoot is a pressing want. Mr. Bryce has computed that the buckets are capable of raising 8,000 or 9,000 tons of material a week, though, since August, they have been raising only 5,000 to 6,000 tons, owing to defects in the sluice boxes.

A stream of water, raised by a 10-inch centrifugal pump, sweeps the wash down the shoot into a revolving trommel or screen, 4 feet in diameter and 8 feet 6 inches long, punched with $\frac{3}{8}$ and $\frac{1}{2}$-inch holes. All the tin ore here being very fine, $\frac{3}{16}$-inch holes would, in Mr. Bryce's opinion, be quite large enough. If the material were put through two screens, preferably concentric, there would be far less material to go over the tables, and a greater amount of wash could be put through in a given time, with a correspondingly greater chance of saving the tin.

From the trommel the coarse material discharges onto a shoot and is washed out astern, while the finer wash, carrying the tinstone, passes through the screen onto side shoots (one of which, it is interesting to note, owing to the motion of the trommel, receives nearly double the quantity of the other), and thence is swept on to two sluice boxes or tables running out beyond the stern. These boxes are 4 feet wide and 40 feet long, and are built of iron. The sand is kept 6 inches deep in them, and under 3 inches of water. Most of the tinstone is saved within 5 feet of the top of the tables beyond the trommel shoots. One man with a shovel is stationed there, and keeps the sand stirred up, while, at present, for experimental purposes, another man shovels back the sand in the lower part of the sluices. Owing to the tables not being able to discharge the "wash" from the trommels quickly enough the buckets have to be stopped every now and then; but for this there are two available remedies—namely, to widen the sluice boxes (Mr. Bryce would have them double their present width), or else to use a double screen, as proposed above, so that less of the material raised would have to pass over the tables.

The concentrates from the tables average 7 cwt. to the yard, and are sluiced off in a long tom (10 feet long and 18 inches wide), by two men on the dredger, and then taken ashore to the Willoughby machine shed for final cleaning.

Normally five men are employed on the dredger on each shift, an engineer (who is also winchman and engine-driver), and two men on each sluice box. When the photographs were taken there were two more men on the dredger attending to the long tom. In addition to the above two men are employed in the day shift loading wood, which it may be mentioned costs 8s. a cord here.

Cleaning.—The black and white sand (including a few small topazes), is separated from the ore in a Willoughby machine, which acts on the principle of an upward current separator, and is the invention of a Stanthorpe man. It consists (*see* Plate 3) of an outer tank, with hand pumps and pressure box (if a stream of running water is not available), and a separating box, with false

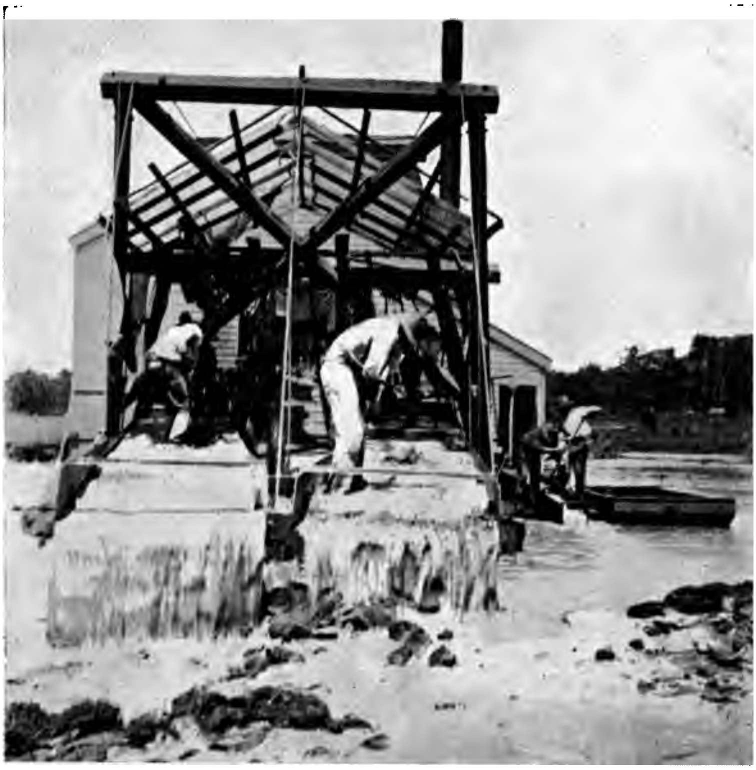


Photo., L.C.B. FIG. 1—WYLIE CREEK DREDGER, STERN VIEW.

LOOKING UP THE SLUICE BOXES.

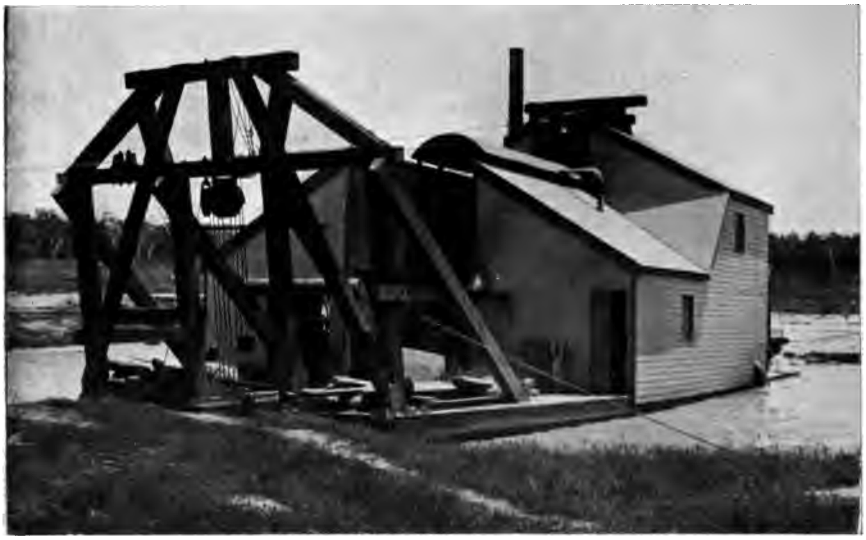
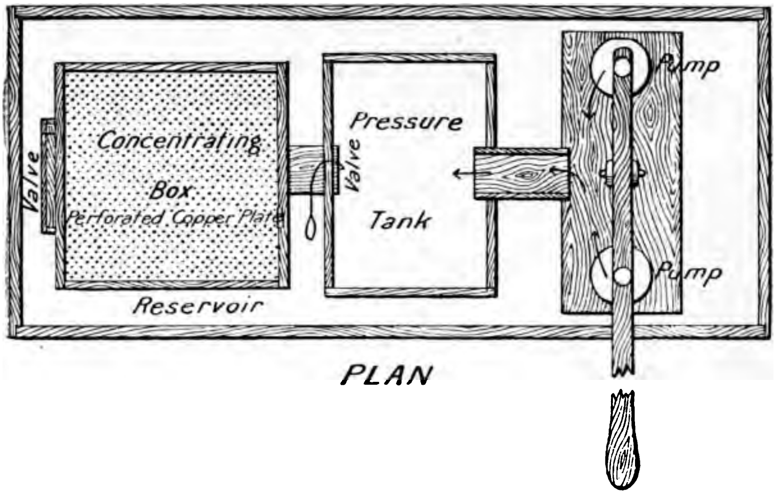


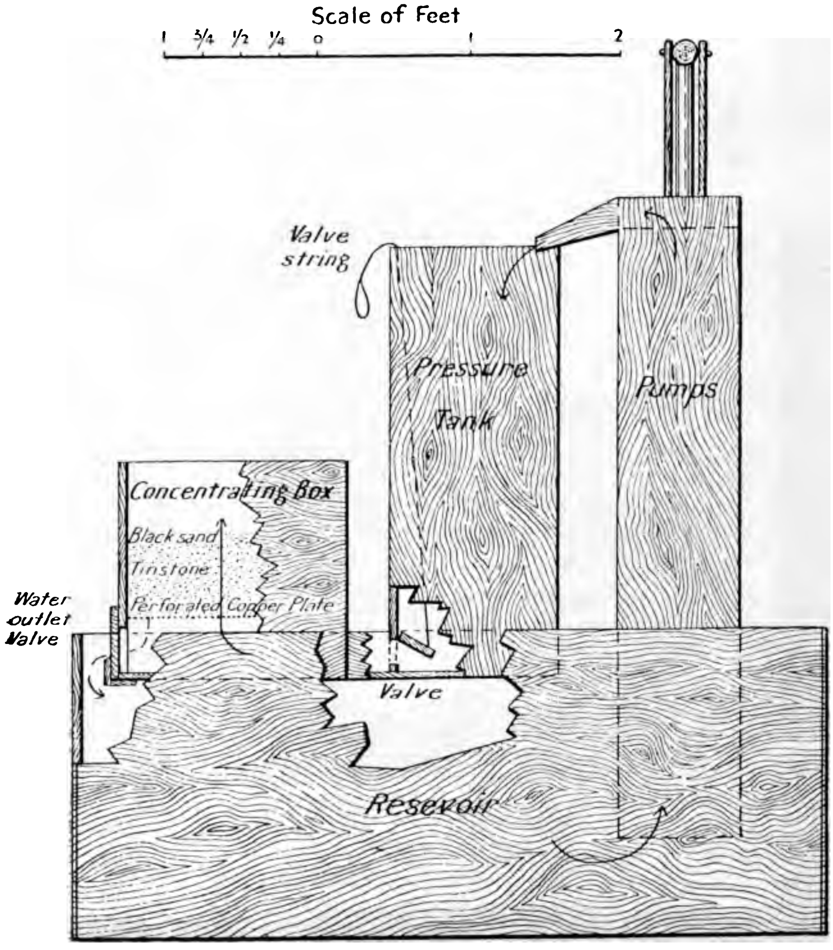
Photo., L.C.B. FIG. 2—WYLIE CREEK DREDGER, BOWS.

SHOWING DREDGER CUTTING INTO BANK OF OLD TAILINGS.

Plate 3.



PLAN



ELEVATION

DIAGRAMATIC SKETCH OF WILLOUGHBY MACHINE.

bottom (a copper plate with $\frac{1}{32}$-inch perforations). The crude ore, about 4 cwt., is placed in this box to a depth of 6 inches, and a stream of water under a head of from 1 to 3 feet is allowed to rise through it, causing the lighter impurities to ascend to the top, where they are scraped off. The operation is repeated about five times, and then the cleaned tin ore (cassiterite) is dried on an iron plate (10 feet by 5 feet in area), heated over a grate. The tinstone, as bagged for shipment, averages 76 per cent. of tin (varying from 75.3 to 76.4 per cent.).

Returns.—On the dredger's trial run 30 cwt. of tin ore was obtained after 255 hours from 10,000 tons of wash, which, however, according to the boring results, should have yielded 10 tons. About 40 tons of ore have thus far (November) been obtained, together with 4 tons of black sand. For the week ending 21st November, 50 cwt. of tinstone was obtained from 5,500 tons of wash on a 114 hours' run. Of this amount between 15 and 20 cwt. probably paid expenses, leaving a very fair profit.

The first dividend of 3d. was declared in October, and was followed by a second in November, and a third in December.

The table below has been compiled from weekly returns published in *The Border Post*:—

Month.	Yield of the Ore.		Hours Working.	Dividends.	
	Tons	cwt.		*s.*	*d.*
December, 1903	8	16·5	397	0	3
November	9	5	436	0	3
October (two weeks)	3	9	306½	...	
September	8	10	371	0	3

The best result was thus about ½ cwt. of tin ore per hour. The Sydney quotation for tin at the end of 1903 was 21s. 6d. per unit.

Conclusion.—The Wylie Creek dredger can now be considered a success, the long interval of inaction between erection and actual working being entirely due to the drought. Mr. Bryce attributes his success to the use of the revolving screen in the first place, and to the employment of a sufficient number of men in the second. The location of the dredger is on a large flat, and the fairly uniform and fine nature of the material treated are prime factors, though the separation by the screen of the coarser stuff has undoubtedly had a very beneficial effect on the saving of the tin and on the total amount of material put through.

It is understood that lately the water has become scarce, and it will probably be necessary to construct a dam above the dredgers for a reservoir.

(*b*) STANTHORPE PROPRIETARY TIN DREDGING COMPANY

(Mr. Martyn, manager).

Locality.—This is a Sydney company, of 25,000 shares, of which the 10,000 are paid up to £1. Leases up to a quarter of a mile in width have been secured from private owners for a distance of 2½ or 3 miles along Quart-pot Creek. These are on the bend round the old Brisbane claim, which has been considered one of the largest and richest alluvial areas in the district. The dredger lies at the south-western and lower end of the leases—3½ miles in a direct line a little south of east of Stanthorpe, the distance by road being 5 miles.

Ground.—Owing to insufficient prospecting by borings, the dredger was erected in one of the worst possible positions, being cut off from the creek by a bar of granite, and from the higher wash by a bar of "cement" a chain wide, running diagonally up the creek for a quarter of a mile. The dredger has done little more during the last six months than cut its way to a depth of 11 feet through this bar.

This "cement" occurs in flat layers from a few inches to several feet thick, and from a few square yards to several acres in area, at various depths beneath the surface. Though generally poor itself in tin ore, there is often tinstone both above and below it. It is composed of granite detritus, chiefly grains of quartz, in a felspathic matrix, and in my opinion it owes its origin to the action of carbonic acid solutions on the felspars. These solutions may have been derived from decaying vegetation above, and have sunk into the rotten granite, causing a complete decomposition of the felspar, the potash going off in solution, while silicate of alumina was precipitated as a cement. The occurrence of occasional rounded pebbles in it might be explained by their having sunk into the mass before the secondary alteration and solidification took place. This rock has been found in most of the workings about Stanthorpe, and will prove one of the most serious obstacles to bucket dredging there.

It is believed that the wash has been mined under the "cement," and it is therefore not intended to drop the buckets to the bottom till the old ground beyond the "bar" is reached. At the end of November softer cement was entered, and the amount of tinstone saved immediately began to increase.

While going through the harder cement blasting had to be done practically all along the face. The holes were placed 6 feet centres in rows 4 feet apart, and 2½ lb. rack-a-rock was fired in each, 5 feet below the water-line. The amount of the hard cement raised was only 2 cubic yards an hour, but in the softer 40 yards is now being raised, and it is expected that the dredger will manage 60 yards in the old ground, which extends (with soft bottom) for a chain to the east of the bar at the southern end, but widens towards the north.

The ground is understood to have been sampled, but for the directors' private information only, so that statistics of the contents are not available. It is said that in the original washdirt the tinstone was mixed with 10 per cent. of black sand. Now, in the old workings there are generally about equal proportions of the two minerals, though, owing to the Chinamen's sluicing, the proportion of black sand to tinstone is often as 5 to 1.

The Dredger.—The dredger was completed in June, 1902, but remained idle for twelve months, owing to the drought. It cost approximately £11,000.

The boiler is a 25-horsepower multitubular semi-loco. with enlarged grate; firewood now costs 11s. per cord, but in the late wet weather it rose to 16s. All the machinery is driven by a 20 nominal horsepower (140 indicated horsepower) condensing engine, with feed-water heater. There are 34 chrome-steel-lipped buckets of 4½ cubic feet capacity, the ladder allowing dredging to 25 feet depth. (*See* Plate 5.) Attached to one of the buckets is a pair of grabhooks for raising logs and boulders.

The material from the buckets is tipped on to a steel shoot, but, owing to the unavoidable clearance space between the buckets and the shoot, clayey and sticky material very often misses the shoot, and falling down the well fouls the bottom of the paddock. A second shoot was therefore installed below the main one, and a trial was made to see if it would pay to treat it in a long tom, but owing to the poverty of the ground ("cement") at the time, the experiment was a failure from a financial point of view. The material is

Plate 4.

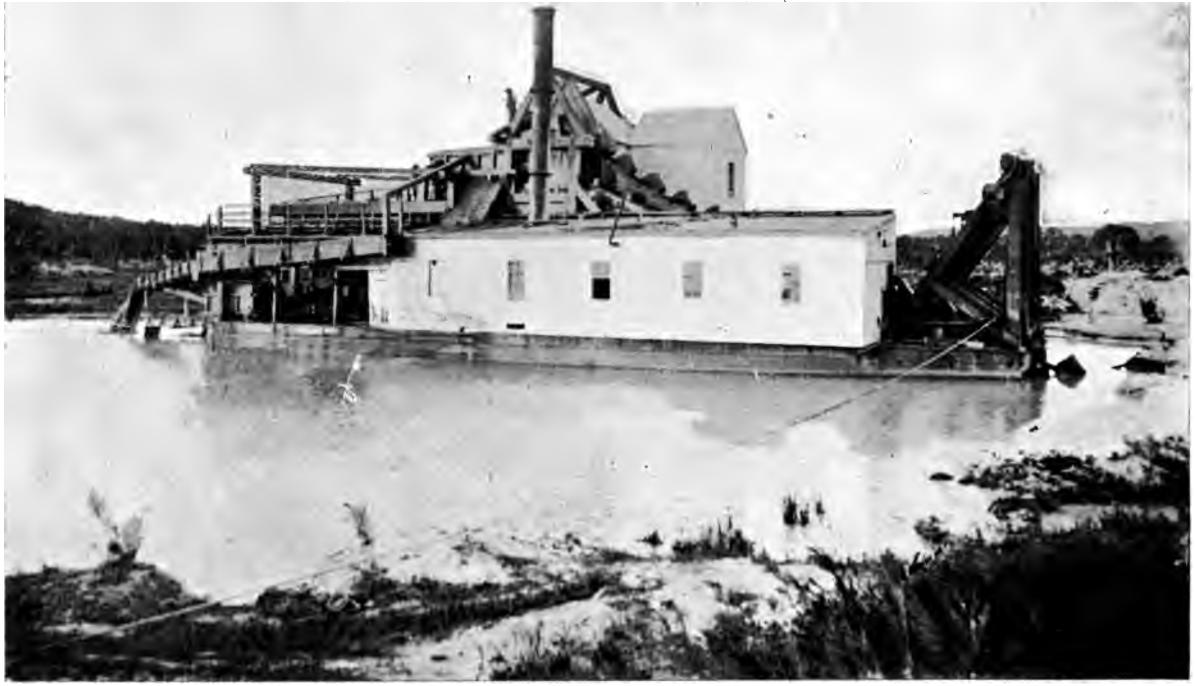


Photo., L.C.B. STANTHORPE PROPRIETARY DREDGER.

Plate 5.

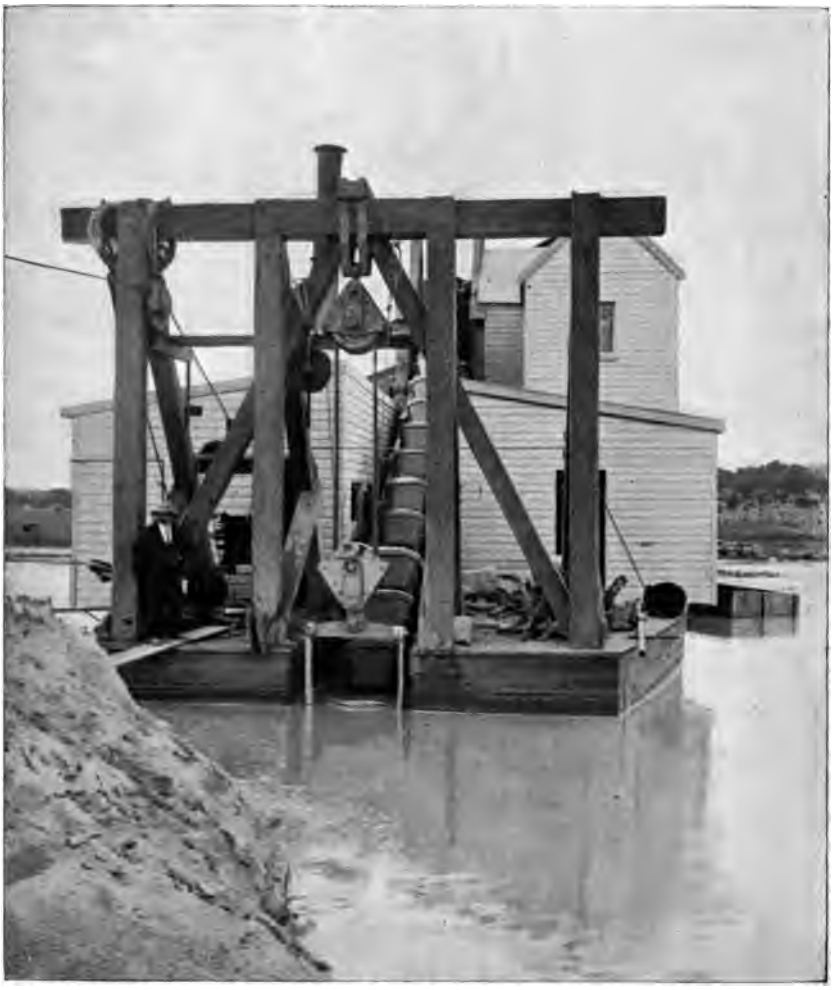


Photo., L.C.B. STANTHORPE PROPRIETARY DREDGER, BOWS.

SHOWING METHOD OF SUSPENDING "LADDER."

Plate 6.

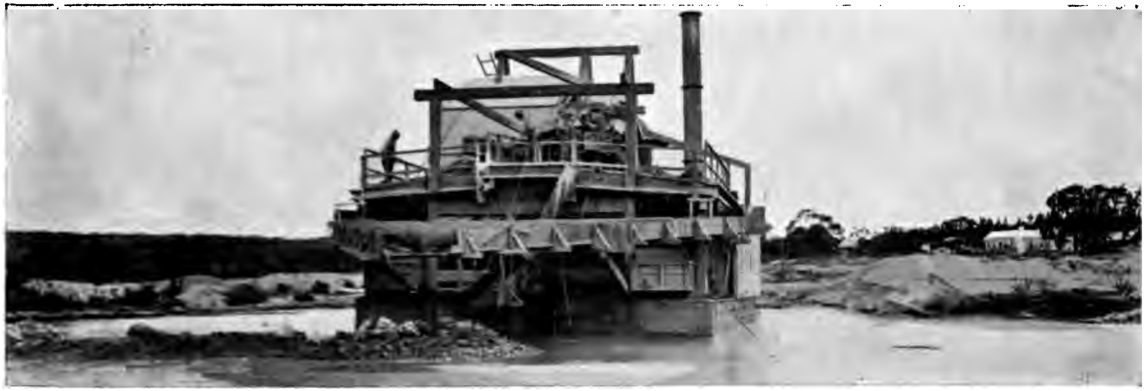


Photo., L.C.B.

STANTHORPE PROPRIETARY DREDGER, STERN.

SHOWING UPPER WORKS AND LAUNDERS FOR COARSE AND FINE TAILINGS.

Plate 7.

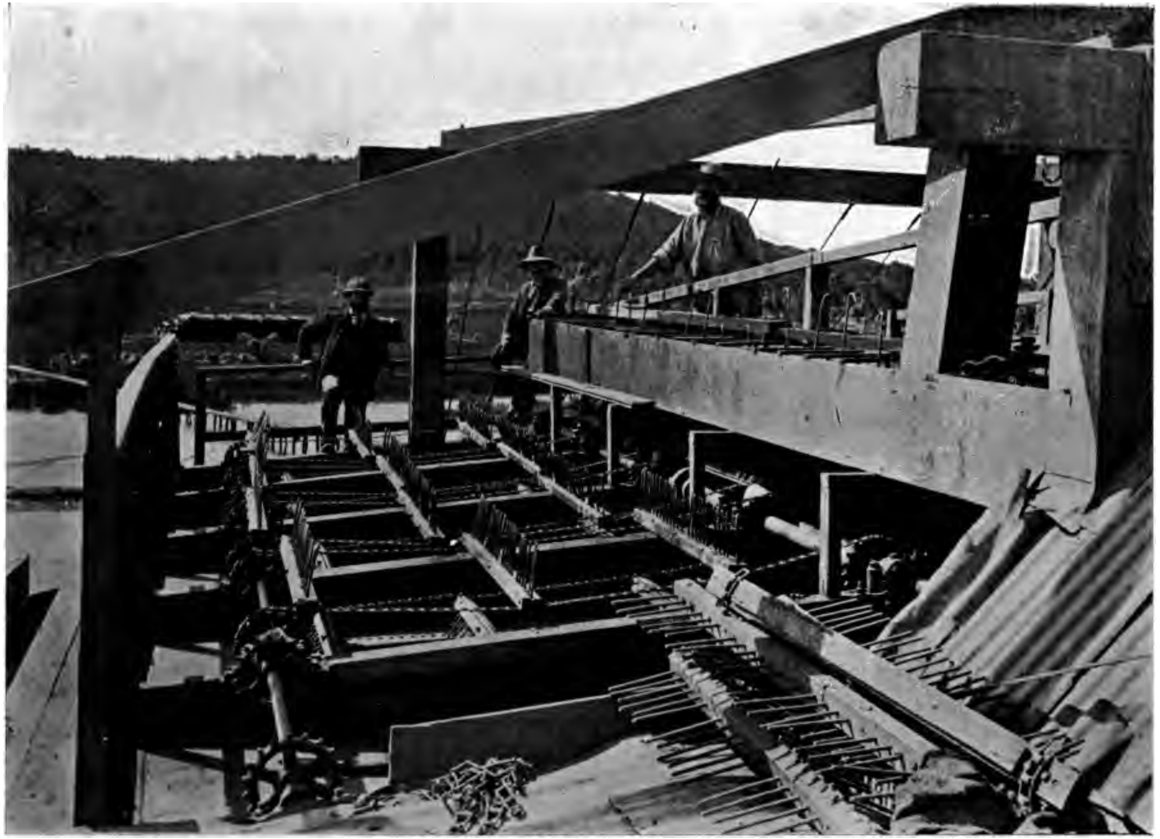


Photo., A. P. Corrie. STIRRING RAKES, STANTHORPE PROPRIETARY DREDGER.

now, therefore, simply run out behind the dredger. From the upper shoot, where it is proposed to have a jet of water, the material is washed by a 12-inch stream of water from a 9,000-gallon pump over a grizzley with bars ⅜ inch apart. This serves instead of a revolving trommel, the finer stanniferous wash falling through on to a central distributing table, 25 feet by 8 feet in area, while the coarser material, including many unbroken lumps of clayey wash, is swept down a launder and banked up astern of the dredger, preventing the fines from the sluice boxes, deposited beyond, settling under the dredger. (*See* Plate 6.)

From the distributing box the tin-bearing sands are washed on to five lateral tables (12 feet long, 5 feet wide, and falling ½ inch in a foot) on each side. The sand is kept stirred in each of the tables by seven rakes, made of ¼-inch iron rods set 1½ inches apart in a wooden bar attached to endless chains worked on toothed wheels. (*See* Plate 7.) Each lateral table is divided longitudinally into four compartments to prevent "guttering." The tendency is for most of the sand to enter the first tables and the water the last, and, therefore, launders with a valve for each compartment have been provided, so that water can be added when necessary. Most of the tinstone saved is within 5 or 6 feet of the top of the tables.

Only one shift has thus far been employed, consisting ordinarily of three men (engineman, fireman, and grizzley man), and two lads (one loading timber—enough for three shifts in one day—and the other on the long tom in connection with the lower drop shoot).

The total expenses, working three shifts and allowing for wear and tear of machinery, for firewood, and salaries, Mr. Martyn has calculated will be £170 per month. About ½ ton of tin ore is now being saved a week (for 30 hours' work), so that, though not in the main ground, the dredge should be just paying expenses. On 3rd December 2 cwt. of cleaned tinstone was saved as the result of five hours' work.

Another of the difficulties here will be in connection with the water supply, but it is hoped that by pumping water from a hole in Quart-pot Creek into the Chinaman's race it will be possible for both ground sluicing and dredging to go on throughout the year. In fact, already a small quantity of water, for renewing that in the paddock, is being derived from the race.

Much of the ground to be dredged will be a flat terrace, slightly above the creek, so that the conditions are not so favourable as at Wylie Creek, for it will often be necessary to build a puddle wall at the lower end of the paddock. The immense boulders of undecomposed granite scattered through the wash, and the beds of hard "cement" so characteristic of the Stanthorpe district, will cause further trouble.

(*c*) BROADWATER PROPRIETARY TIN DREDGING COMPANY.

Locality.—This company has leases for about 2 miles along Broadwater Creek, 6 miles north of Stanthorpe (8½ miles by road). The prospecting bores, sixty in number, put down by the former holders, gave an average of 5 lb. of tinstone per cubic yard, to a depth of 9 feet over a width of 9 chains, for a distance of 110 chains; and an average of 3 lb. per yard, with 6 feet depth and 7 chains width, for a distance of 40 chains. They found the granite bottom soft, and reported finding not a single large boulder.*

Dredger.—The dredger was completed in 1901, and was worked at a loss for several weeks. During the floods in the latter part of 1903, the pontoon became partly submerged, and remained so till February of this year.

*** Annual Report of William H. Rands, Government Geologist, for the year 1900.**

The pontoon is 90 feet long by 30 feet broad, and 7 feet deep. One of Marshall's semi-loco. tubular "Dredger" boilers supplies steam for the winch engine (8-inch diameter and 6-inch stroke), for the main engines (double expansion 12-inch stroke, and 12 and 6 inch diameter) which are provided with feed water-heater and condenser, for the small Crompton engine working the electric light dynamo, and for the various pumps. Firewood is expected to cost not more than 8s. a cord.

The buckets, thirty in number, have a capacity of 4½ cubic feet, and are capable of raising 2 cubic yards of wash a minute.

The wash from the buckets was tipped on to a steel plate 6 feet long and 4 feet wide, and thence washed down by water from a four-valved tank onto a wooden sluice box, extending out to the stern. This is 7 feet wide at the top end, and 6 feet at the bottom, and has a length of 25 feet, with a fall of about 6 inches. A 4-inch slit near the bottom of the sluice allowed the heavy fines to drop through into a three-compartmented sluice (10 feet long, and falling 3 feet), running back towards the bows, and discharging into a pointed box, where upward current separation of the tinstone and sand was attempted. The coarser material in the sluice box was carried 15 feet beyond the stern in a launder 7 feet wide.

Ground.—The face worked was about 2 chains wide, and the dredger probably worked forward about 3 chains, but no tin seems to have been saved. The greater part of the wash turned over was fine sand with pebbles of crystallised (chiefly smoky) quartz, and it is considered that the old tailings average at least 1¼ lb. of tinstone per cubic yard. A little gold is sometimes found with the tin, and a prospector living in the vicinity showed me three small diamonds, a very light-coloured beryl (a crystal ½ inch long), and several topazes. The largest of the diamonds, a white, slightly pitted and encrusted hexakis-octahedron, was ½ carat in weight; the second, ¼ carat in weight, slightly off colour, had a roughly cubical form, but was covered with very numerous facets, and the third was a yellow fragment, ⅓ of a carat in weight. The wash is reported to have been from 10 to 14 feet deep, but the tin is known to have run in very narrow shoots, as the old workings show.

The average depth of dredgable ground over the whole property is taken as 9 feet. There is a clear width of 7 or 8 chains between the rocks, where the dredger is now, but some 5 chains below the dredger the rocks on opposite sides are only 3 or 4 chains apart, and a few chains above the dredger is a granite bar, above which the dredgable portion averages 5 chains in width, and extends for about 30 chains. For 40 chains below the flat where the dredger is now, the ground is undredgable, or else very poor, except for small patches a few chains broad and long, but further on is a 15-acre triangular area, 6 to 9 feet deep, which has been well turned over by the miner.

Working.—In order to work the ground on these leases dams will have to be constructed for a water supply, and the dredger will have to be floated over the rocky portions by building weirs. Luckily, the rocky part below the dredger has a very slight fall (25 feet in a mile), and only two weirs will be necessary there. It is difficult to understand why the dredger was erected in its present position—namely, in the centre of the lease— for it will be necessary now to work towards one end, and then to get at the ground at the opposite end the dredger will have either to be dismantled and re-erected, or else it will have to dredge its way back through its own tailings.

Mr. Martyn (the superintendent of the Stanthorpe Proprietary dredger) has lately taken charge of this dredger. He has pumped out the pontoon, refloated it, and proposes to dismantle the whole of the tin-saving appliances, replacing them by an entirely different design. The cause of the failure of this dredger is put down entirely to the inefficiency of the tin-saving appliances.

(*d*) SHEEHAN'S.

Mr. Rands, in his annual report for 1900, besides referring to the building of the Broadwater and Brisbane dredgers, mentions Sheehan's property on Broadwater, 4 miles slightly north of west of Stanthorpe. "Large amount of water. . . a series of waterholes. . . and only the shallow ground worked. . . Dredgable for 8 or 10 chains width and 14 to 16 feet depth. . . Conditions satisfactory, but no boreholes."

I heard when leaving Stanthorpe that a suction dredge had been brought from New South Wales and tried on Sheehan's, but that it had been a failure, had been dismantled, and was being removed to New South Wales again.

Mr. Sheehan has since forwarded me the following particulars:—70-horse-power multitubular loco-type steam boiler; No. 4 Knowles's duplex steam feed-pump; pair Morris Machine Company's vertical engines, direct coupled to a No. 8 sand pump, 8-inch delivery and suction, driven at about 300 revolutions per minute; capacity 30 yards of solids per hour. About 1,100 yards were taken out of the paddock, under great difficulties, owing to lack of water. Yield 1½ tons of tin ore—a little over 3 lb. to the yard. It was dismantled because capital not sufficient to construct a dam for conserving water, to purchase a break-down pump, and to obtain a proper set of boxes. Both washdirt and overburden are chiefly coarse sand and gravel.

(*e*) PROSPECTING ON FOUR-MILE CREEK.

Locality.—Four-mile Creek rises on the border of Queensland and New South Wales, about 6 miles north-north-east of Stanthorpe, and flows in a general southerly direction to within 1½ miles of that town, when it bends to the south-east, and after several windings enters Quart-pot Creek. In its lower part it is known as Kettle Swamp and Law's Gully. Its fall is nowhere rapid, and its catchment area as a whole, especially near the creek itself, is flat. Machine Gully enters it from the east, about 3 miles north-east of Stanthorpe.

Tenure.—After most of the ground had been turned over by small claim holders, all likely ground was either selected or bought at auction, and is now freehold property. Thus, before operations can be started, arrangements have to be made with the owners, and it is generally conceded that the difficulty in coming to terms is one of the greatest drawbacks to alluvial mining in this district.

Messrs. Gibbs, Bright and Company some months since secured an option over the ground on Four-mile Creek from block 238 to 367 inclusive, a total length of 2 miles, of which probably only 1 mile will be dredgable. On the expiry of their option, being unable to obtain an extension, and their engineer (Mr. Hawley), having advised that the ground seemed worth prospecting, they decided to take a lease for fifteen years. This company is engaging on alluvial tin mining on a commercial base rather than a speculative one, finding that it is better to spend several hundred pounds on prospecting operations, and perchance prove the ground valueless, than to spend thousands installing costly machinery and then to make the same discovery or to find the material too poor to pay to work.

Prospecting.—Mr. Hawley, who is engineer in charge of operations, has been for several weeks surveying the ground to be prospected, and marking out the sites of the proposed bores. He himself took me over the leases, and has been good enough to give me the following particulars as to the work.

The method of prospecting employed here is that of 100 feet square intersections—lines of bores 100 feet apart being run along the creek and at right-angles to it. The ground between each four bores is assumed to contain the mean of the four results obtained. The average number of bores on each side of the creek is five (from three to seven), and there will be fifty-six rows along the creek, making, together with special bores (two rows on each side of Machine Gully), a total of about 600. It is believed that the average width will be 8 chains. The average depth of the ground to be dredged will be 7 to 8 feet.

Till lately only one boring plant was in operation, but a second was installed early in December, and in a short time a third was to be working, the three employing twelve to fifteen men for the following two months. By the end of January or the middle of February it was expected that sufficient information would have been collected for it to be decided whether the venture was worth going on with.

Each boring plant consists of a light derrick—three light timber legs with windlass attached—erected over the site of the bore for raising the boring apparatus, the lift amounting to about 20 feet. The only tools employed are a 5-inch auger (for surface work only), a 3¾-inch auger, a chisel, and an 18-inch pump for use inside the casing. These tools are attached to 1-inch square iron rods (made in 4-feet lengths), suspended from the derrick by a ⅛-inch wire rope connected to the windlass. The borehole is lined with ¼-inch iron casing, 4 inches in internal diameter, made in 4-feet lengths, with flush joints.

Four men are employed at each bore, one winchman, two sinkers—*i.e.*, men to remove and replace the tools and to give the augers the necessary turning movement while sinking—and one washer (who "pans off" the wash-dirt).

All the material raised is carefully transferred to a cubical box with 12-inch sides, the water is decanted, and the material is stamped down firmly and the height in the box measured. The contents are then calculated with the aid of a table, and checked by the calculated contents of the bore, the measured exceeding the calculated by an average of 5 per cent., owing to the washing in of the material round the bore hole. The whole is then carefully panned off, and the concentrates cleaned to an average of 74 per cent. tin, weighed to the nearest grain, and then from a table the amount of tin ore per cubic yard is found to within an estimated 2 per cent. of the actual contents.

The average rate per day is three to four bores (9 feet 6 inches deep) per plant. Exceptional depths of 22 and 23 feet are reached, but greater depths than 15 feet are seldom found. During the last fortnight (end November and beginning December) eighty-three bores had been put down with two plants (during part of the time), and sixty a week were expected with three plants in operation.

By the time prospecting operations have been finished here, £1,500 or £1,600 will have been expended, of which £750 or £1,000 will have been on boring alone—the average cost per foot here being 1s. 6d.

The Ground.—It is proposed to dredge only about 1½ mile of the lease—*i.e.*, from the centre of selection 253 to 259. The lowest part of the lease has

Plate 8.

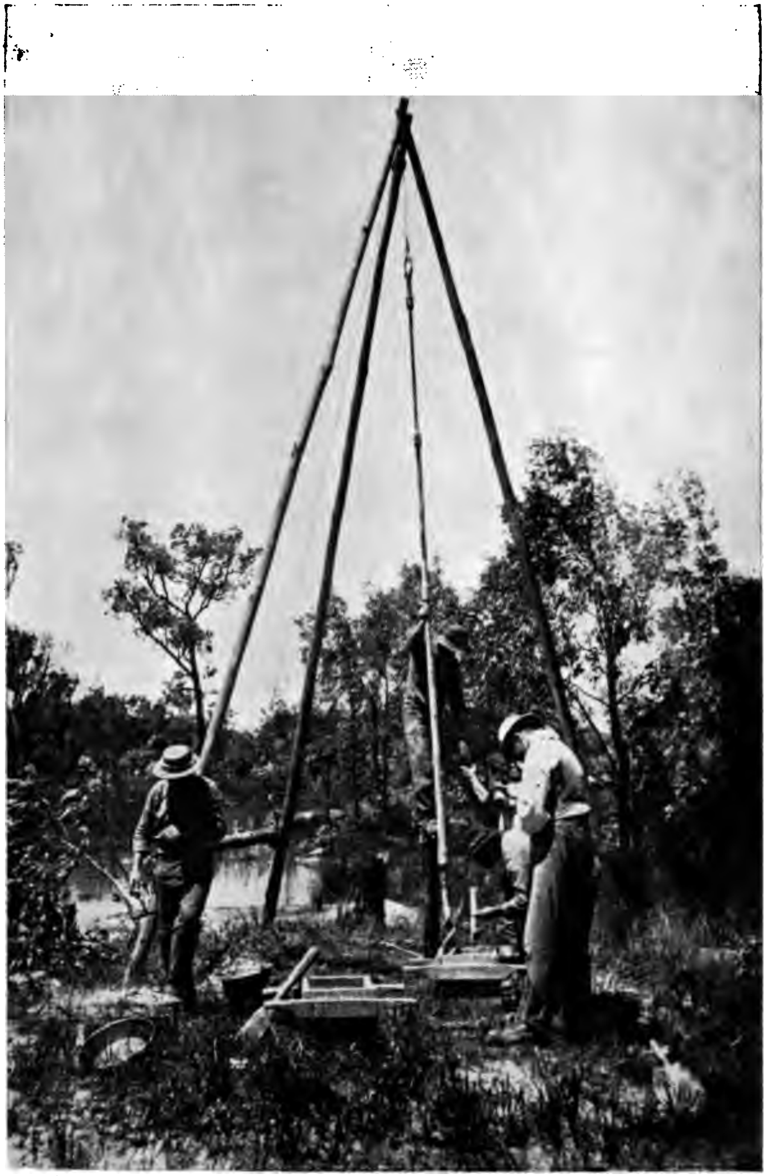


Photo., L.C.B.

PROSPECTING BORING PLANT, 4-MILE CREEK, STANTHORPE.

Showing Auger, Pump, Cubical Contents Boxes, Etc.

been well turned over, but is separated by many chains of rocky ground from the main portion, and will therefore not be dredged. The richest part of the lease is about the mouth of Machine Gully, and from there it is intended to work Four-mile Creek down for half a mile and up for one mile, and Machine Gully up for half a mile. The ground has thus far proved very patchy, several parts being rich enough to pay for ground sluicing, while others are too poor for dredging. The few prospects I saw from the bores consisted in great part of "rosin" and ruby tinstone, free from black sand. The tailings distributed over most of the flat are said to contain from ½ to 1½ oz. of tinstone to the dish. The overburden has been proved to be practically barren of tinstone, and some method will be devised for getting rid of it without passing it through the tin-saving apparatus. The bedrock in the deeper dredgable parts is soft decomposed granite, which generally hardens as the rock approaches the surface up the sides, while the tinstone contents at the same time increase in coarseness. The slope on the western side is believed to be valueless for dredging, being poor and shallow.

Mr. Hawley informed me that from one of the first bores a pale straw-coloured diamond, of the size of a pea, was obtained.

The original owners of the land sank 260 bores on the 2 miles of the claim, but not in any sequence, and without including the 3 feet of surface material in their calculations; and, in consequence, an exaggerated idea of the amount of tinstone in the ground was formed.

Dredgers.—Owing to the general scarcity of water in this locality, it is not unlikely that a large dredger would be laid up during three or four months in a year, and Mr. Hawley will propose, if dredging is to be carried on, to install several small suction dredgers, worked by motors from one central electrical power station. The three great obstacles to dredging—want of water, layers of "cement," and huge boulders—would be thus to some extent overcome. One of the chief reasons for preferring the suction dredger is that the bedrock will be exposed to view, and, if decomposed, will not be broken into as it might if a bucket dredger did the work. The ground on the shallower slopes not to be reached by the dredger will be sluiced down with nozzles to within reach of the suction pipes. In addition, the smaller plants will be more mobile, and less time will be wasted in repairs. However, it will not be actually decided to install dredgers until the results of the bores have been obtained, though I think these have been, on the whole, favourable.

IV.—LODE TIN MINING.

Mr. Skertchley in his report* on the Stanthorpe district, says, p. 42:—

"I. The stream tin is not derived from lodes, but from two distinct sources of probably contemporaneous origin: (*a*) the greisen, or altered granite of the joint planes; (*b*) the dykes, chiefly elvan. . . . 3. The whole of the greisen and much of the elvan is, by constant weathering, releasing tin and forming what is known as surface tin. . . . quite crystalline and unworn. 7. The richness of the stream tin is no proof whatever, or even an indication, of the existence of rich lodes; but was due to the long-continued denudation of very widespread though poor stanniferous rock." With all this I am in entire agreement, except that it is quite possible, though perhaps not probable, that payable stanniferous lodes may yet be found.

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* *Op. cit.*

(*a*) THE BALLANDEAN TIN MINING COMPANY.

The Ballandean Tin Mining Company has secured a lease from the owner of a 500-acre unconditional selection on the left bank of the Severn River, 6 miles west of Ballandean Railway Station, with the intention of testing several adjacent veinlets of tin ore outcropping on a ridge-top there.

The country rock is clay-slate which, along the joints striking about north-north-east to north-east, and dipping west-north-west, has been greisenised, and there carries bunches of large crystals of tinstone (½-inch diameter). These micaceous joints are found over a width of 107 feet on the surface, the total amount of tin present being only a fraction of a unit per cent. The hope was reasonable that a payable patch of tin ore might be found at a greater depth, and, therefore, an adit was opened from the west at about 40 feet below the hilltop, but though the main joints were found at 26, 44, and 61 feet to be mineralised with mispickel, they contain scarcely any tinstone. A drive is being opened to the south on the last mentioned joint, where there is 6 to 9 inches of quartz, besides 2 feet of cupriferous mispickel, which practically cuts out on the opposite side of the adit. The adit has been carried in a total of 81 feet. A small granite vein in the face points to the main granite mass being at no great depth. I can see no promise of a permanent lode being found here, but it might be some satisfaction to sink on the third vein to a depth of, say, 50 feet, as a bunch of rich ore might be found.

Rich stanniferous and mispickel-bearing veins (similar to those at Red Rock), on north-east joints are to be seen in the granite below the slates on the southern side of the Severn River, half a mile north-west of this adit. Several hundredweight of ore (50 per cent. tinstone) was obtained from one of these, and more could be got, but permanency is not to be expected. Several prospecting trenches were opened in the locality a few months ago, one of which exposes greisen carrying a little molybdenite and tinstone, but in too small quantities to be worth holding.

(*b*) LATE PROSPECTING AT RED ROCK.

During the last month (November) two claims have been pegged out about a mile east-north-east of the Sundown Mine, on one of the branch gullies opening into Red Rock Creek. They are near the centre of an area formerly held under mining lease.

Mr. Skertchley refers to the granite boss of Red Rock as being euritic, with north-north-west master joints. Mr. Rands visited the locality in 1883, and found a shaft and trenches, reported to be on a 20-inch quartz reef, with strings of ore.

P. A. 49 (Morris Claim).—This, which is on the eastern side of the old M. L. 814, is reached after a stiff climb of over 550 feet down from the Sundown road. The country on the south is slate, but there is a gradual passage down the hill to the granite below. The Sundown Mine (in slate) is 1,200 feet below the range top, but the junction of the slate and granite here is only 750 feet below it, the granite having intruded further in to the slates here.

Morris has begun a shaft in altered slates containing mica, copper stains, and finely-disseminated tinstone, but as yet the formation is not well-defined, and enough work has not been done for its value to be determined.

About a chain to the north and 70 feet below is an old shaft on, to judge by the tip, felspar rock, containing crystals of tinstone up to ⅓-inch in diameter, with veins of crystallised quartz. Some 50 yards below the shaft is an old open cut, the result of a company's work two or three years ago. The country here is still slate, the ore, bunches of tin-bearing quartz and soft replaced slate, occurring on joints. The company burnt and dollied the ore, which, to judge from what they left, must have been very rich.

P. A. 51 (Gunn's and Eli's Claim).—This adjoins P. A. 49 on the north, and is wholly in granite—very siliceous and felspathic, with joints striking north-east to east-north-east, and dipping south-east. At the north-eastern end of the tried ground is a trench 10 feet long and 2 feet deep, on a 6-inch vein of almost pure cassiterite, with a little soft matrix, in a joint in granular quartzose granite. Towards the south-west several small veins, carrying tinstone, have been exposed over a width of 5 feet, and the ore has been traced for 3 chains to the south-west. A shaft in slates on the ridge, a quarter of a mile beyond, is believed to be on the same line, though the tinstone has not been found beyond the granite. The prospectors wish to have a battery erected at once, but it would be much wiser for a small company to thoroughly test the ground by trenches and shallow shafts and crosscuts. The amount of work yet done is quite insufficient to show the nature of the deposits. The largest trench rather points to the main vein of ore pinching within a couple of feet of the surface. I am inclined to believe that the tinstone has, near the surface, been somewhat concentrated, not only mechanically but chemically. If the zone 5 feet wide is proved to carry 5 per cent. of tinstone, there should be no doubt as to the advisability of erecting a battery. A certain amount of difficulty will be experienced in reaching the main road, owing to a climb of over 1,000 feet within half a mile, but an entirely new road could be made, at some expense, round to the Red Rock Creek Crossing.

The other old workings in this locality were not seen.

2.—Notes on Copper and Silver Mines near Stanthorpe.

I.—SUNDOWN COPPER MINE.

Locality.—This is a reward copper claim—the old M. L. 24, the only one in existence of twenty-eight mining leases at one time held in the country between Red Rock and Sundown Creeks. It is on a branch gully from Sundown Creek, 3 miles above the Severn River and 28 miles south-west of Stanthorpe. The hills over which the Stanthorpe road passes rise 1,200 feet above the mine, within a distance of a mile, so that there was a great difficulty in making the road in the first place, and in using it in the second. It is proposed, in the event of operations being again begun, to construct an aerial tramway to do away with the necessity for the road for most purposes.

The only workings in existence at the time of Mr. Skertchley's visit* were on the opposite side of the creek (Clare's open cut). The last work was done in December, 1900, at which time £5,875 had been expended. The present holders are endeavouring to raise capital to prove the lode.

General Surface.—From the mine a tramline ran down to the reverberatory smelter, 7 chains distant. This put through 70 tons a week, the last smelting of 150 tons taking 16 days. The only building now standing besides the furnace-shed is the assay office.

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* *See* G.S.Q. Publication, 120.

Firewood was swung on wire ropes across to the furnace from the adjacent hills and ridges, it being impossible for vehicles to negotiate the country.

There is no natural permanent water supply here, the gullies being deep and narrow but short and steep, allowing the rain water falling in them to quickly run off. It would be possible to conserve a sufficient supply by one or more small dams.

Mine Workings.—The mine workings include an adit 270 feet in length along the lode—*i.e.*, to the north-east and east-north-east, about 50 feet above the bottom of the valley, and 70 feet below the ridge top. Half way in a 60-feet shaft connects with the surface, and at 100, 135, and 250 feet from the mouth are winzes 15, 50, and 26 feet deep respectively. At the bottom of the second winze drives 30 and 53 feet in length, south and north, have been opened, and are reported to be in ore. There is said to be 4 feet of ore in the bottom of the third winze. These are now all inaccessible, the main one being flooded.

An overhand stope extends from the mouth of the adit to within 50 feet of the end (where the lode is 3 feet 6 inches wide, with a 9-inch cherty centre) for from 20 to 10 feet above the drive.

The adit seems to have been opened in slate, but at 15 feet from the mouth grey arsenical material, 2 feet in width, begins, and continues for 5 feet, beyond which the stopes begin.

The ore is, as a rule, not easily separated from the country—gradually passing into it—but there are well-defined walls, within a few inches or a few feet of the lode. The lode increases in thickness from 2 feet near the mouth of the adit to 5 feet at the second (main) winze, then decreases to 3 feet, but again, at the third winze, spreads out to 7 feet width, including much country. It seems to have split up then, and one of the branches has been followed, and is widening in the face, where it contains (Government Analyst):—

Gold	16 gr. per ton
Silver	16 oz. „
Copper	11·8 per cent.

The main branch is probably to the east-south-east of the end of the adit. The lode is made up of lenticular bunches, as may be especially well seen at the top of the stopes near the shaft. Great and sudden variations in thickness sometimes take place within a few inches, owing to the occurrence of flat floors or flaws, and the ore extending further on one side than the other. The ore consists in greater part of mispickel, but with considerable quantities of chalcopyrite and quartz, and a little cassiterite.

In 1899, 30 tons of ore were sent to Cockle Creek, and ran 11½ per cent. copper, with silver and gold in addition. The last smelting (150 tons of ore) made locally, produced 25 tons of matte containing 29 per cent. copper, with 76 oz. silver and 6 dwt. gold per ton, showing that the ore averaged 4.83 per cent. copper, 12 oz. 13 dwt. silver per ton, and 1 dwt. gold per ton.

Geology.—The country rock is a highly altered, fine-grained sedimentary, the true bedding of which is not distinguishable, owing to metamorphism the secondary jointing. Granite is reported to occur on Mount McDonnell, 2 miles south-west of the mine, and on Mr. Skertchley's map a small patch is shown on the Severn River, just above the entrance of Sundown Creek. Their occurrence, together with that of the Red Rock boss, go to prove that the whole of the area is underlaid at no great distance by granite, though the mineralogical nature of the lodes would alone suffice to indicate that. It seems plain that the minerals have been given off by the cooling intrusive granite, and precipitated in fissures and joints in the sedimentaries above. The ore deposits at Sundown all lie on one zone, but probably in separate fissures. It is quite possible, considering the small deposits of staniferous ores in the vicinity, that in the Sundown lode the amount of copper will decrease at a depth, and the tin increase. It is also most likely that there will be rich ore at the junction of the slates and granite.

II.—WORKINGS IN THE VICINITY OF THE SUNDOWN MINE.

Clare's Open Cut (the Great Eastern or Tin Mine), is 10 chains south-west across the gully from the mouth of the adit, and is included in M. L. 24. The tinstone is chiefly in joints in the slates, but where the rock is greisenised the mineral occurs throughout it, often included in mispickel which has replaced the slate; 20 tons of tinstone are said to have been obtained by dollying and sluicing a formation 7 feet wide.

A shaft was sunk in the bottom of the open cut, but has been filled in again. From the knowledge that the tinstone came from the granite below one would expect to find other deposits in depth, though prospecting for them might not be a payable venture. Wolfram was reported to have been almost as plentiful as tinstone, though little is now to be seen.

Beacroft's.—On the hillside, 330 feet above, and nearly half a mile south-west of the Sundown adit, are old workings on M. L. 23—trenches and potholes on the ridge-top, and shaft and open cut on the north-eastern slope. In the trenches vertical joints in slate are seen striking north-east, and along them lie bunches of mispickel carrying small crystals of tinstone. The main shaft is 30 feet below, and a chain north-east of the trenches; it is said to be 100 feet deep, but is now inaccessible. The mispickel ore obtained, together with a little pyrite and cupriferous pyrite, at a depth, carried small quantities of tinstone. The country is slate.

An open cut 10 yards to the north-east and 30 feet below the brace of the shaft simply shows, in much-jointed and impregnated slates, a zone 4 feet wide of stained and decomposed country with stanniferous mispickel ore in bunches up to 2 feet in diameter. The ore in the decomposed surface portion was washed in a cradle, to separate the tinstone.

An adit was begun 35 feet below, on a formation with slightly more tinstone than in the open cut, indicating a more promising state of things as the granite is approached. No copper carbonate is to be seen, but abundant scorodite (hydrous arsenate of iron).

About 10 chains north-east of the Sundown adit on the north-eastern side of the same ridge, arsenopyrite in slate has been trenched on, but little of promise can now be seen. A small open cut, 10 chains further up the ridge to the east-north-east, shows an interesting occurrence of pyrite, arsenopyrite, blende, cassiterite, hornblende, &c., in slate, proving the granite is at no great depth. Owing to the water in the open cut, the whole ore body could not be seen, but Mr. Skertchley gives its greatest width as 3 feet.

III.—SILVER QUEEN SILVER MINE.

The mineral lease (No. 72), of 40 acres, lies on the right bank of the Severn River, a little over 6 miles west of Ballandean Railway Station, and a mile west of the tin-sluicers' claims. It was secured in the beginning of 1899, and worked with sixteen men for two years, during which time £3,000 was spent on mining and road-making.

Workings.—Five shafts have been sunk along the line of lode. The main, or "prospecting" shaft (No. 5), is on the ridge-top, 50 feet above the river, and its total depth is 100 feet. At 35 feet depth is a level to the north-east for 10 feet, in slightly copper-stained strongly pyritous decomposed saccharoidal siliceous country, and another to the south-east for 6 feet in highly altered slightly copper-stained country. Ore is reported to have crossed the shaft between the 35 and 60-feet levels.

At 60 feet depth is a crosscut to the west for 10 feet to a winze on the lode, which here has a width of from 12 to 20 feet. This winze was also sunk to the 100-feet level, but, like the main shaft, it is now flooded below the 60-feet level.

Mr. Rodda, the former manager, has informed me that at the 100-feet level is a 30-feet crosscut to the west; and a drive, 100 feet in length, proves a shoot of ore 60 feet long. At the western end of the drive is a crosscut proved 20 feet of ore. The ore body in the No. 4 shaft at the surface was believed to have been cut by the eastern drive. A crosscut to the north reached slate in 40 feet.

About 500 tons of ore lie at grass, and rather more mullock. A sample of the ore assays (Government Analyst):—

Gold	16 gr. per ton
Silver	17 oz. 12 dwt. 0 gr. „
Copper	1·26 per cent.
Lead	7·0 „
Zinc	8·8 „

A trench to the west exposes fine-grained quartz-felspar-porphyry, but no ore. The ore has, however, been followed to the east to the river. The first shaft (No. 4), an underlie 70 feet deep, is 1 chain east of the main shaft; in it, or in the 17-feet crosscut on the south, at 50 feet depth, a little poor mispickel was found. The second (No. 3), 1 chain further east, is on pyritous stone, believed to be a formation. There is a big outcrop of decomposed porphyry, stained with copper carbonates, about a chain beyond, and an open cut, 10 yards across and 10 feet deep, with shallow shafts partly filled in. The ore raised here (about 10 tons of siliceous mispickel) does not look very promising. In the last shaft, half a chain beyond, only traces of ore were found. The river is only 30 feet below this.

Output.—Forty tons of picked ore have been sent to Cockle Creek, in different parcels, yielding from 2½ to 4½ per cent. copper, 15 per cent. lead, and 8½ to 16 oz. silver (average 12 oz.), the siliceous ore being richer in silver.

Geology.—These deposits consist of impregnations and replacements of the northern parts of a quartz-felspar-porphyry dyke (which is of extremely variable coarseness), the replacing minerals consisting chiefly of pyrite, with galena, chalcopyrite, and a little arsenopyrite, zincblende, &c., the last filling interspaces between the quartz crystals. The ore is bunchy, and, though the bunches may contain large quantities, work will be expensive. The value of the ore is stated to be about £4 a ton.

The presence of the blende is rather unfortunate, for the amount would be largely increased by concentration, though perhaps not to the extent of preventing the smelting of the concentrate. It is, however, possible that if the percentage proved very high the concentrates could be shipped to an oil-concentrating works, where there should be no difficulty in separating the minerals. Certain of the wet processes for copper extraction, such as Neill's or Van Arsdale's, or the new Hunt and Douglas, are as likely as any to enable this ore to be profitably treated.

Plate 9.

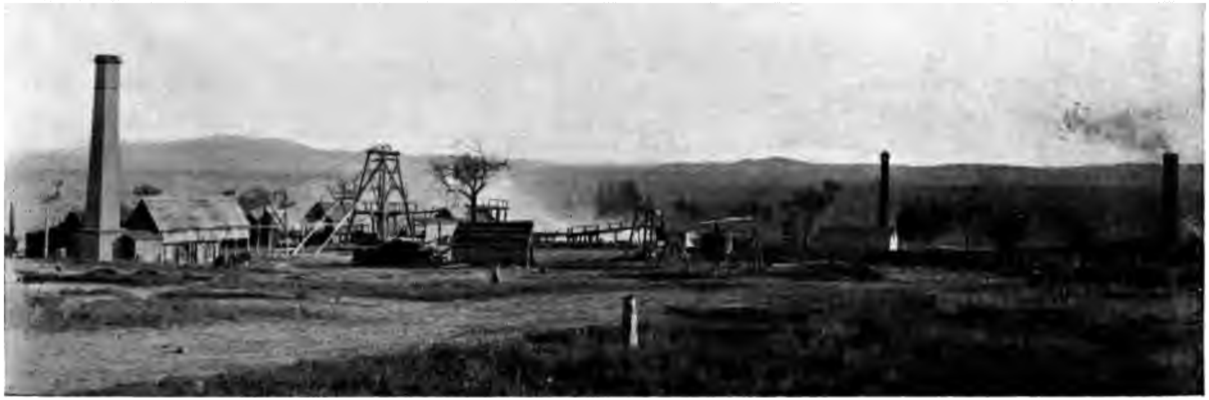

Photo., L.C.B. GENERAL SURFACE VIEW, SILVER SPUR.

Showing Winding-house, Poppet Legs, Roast Heaps, and New and Old Reverberatory Furnace Sheds.

IV.—PIKEDALE SILVER MINE.

The Pikedale Silver Mine is on freehold block 802, near Pikedale Head Station, and within a few chains of the Silver Spur road, 20 miles west of Stanthorpe.

The mine is not now being worked, but was visited by Mr. Skertchley in 1897, a year before it closed.* There were then six shafts, the deepest 84 feet (now 170 feet) deep. Mr. Skertchley gives the thickness of the lode as from 1 to 3 feet. The ore contains silver, gold, copper, lead, zinc, iron, manganese, &c., but, unfortunately, no analyses have been published. A furnace was erected on the ground, and the matte produced shipped to Europe. Mr. W. G. Rodda, late manager of the mine, tells me that he smelted 750 tons of ore, producing 100 tons of matte, containing 30 to 40 per cent. copper, 150 to 300 oz. per ton silver, and ½ oz. per ton gold, valued at £3,000 in Swansea. This gives the contents of the ore as:—

Copper	4 to 5½ per cent.
Silver	20 to 40 oz. per ton
Gold	1 dwt. 8 gr. per ton

Mr. Rodda affirms that the lode averages 6 feet in width, and contains from 2½ to 5½ per cent. copper, and from 16 to 40 oz. (average 25 oz.) per ton silver.

The refractory nature of the ore seems to have caused some trouble, but the large amount of non-contributing shares are held to be the chief cause of the mine's present idleness.

3.—Notes on Mines near Texas (Stanthorpe District.)

1.—SILVER SPUR SILVER MINE.

(*a*) Locality.

Silver Spur lies west-south-west of Stanthorpe, 44 miles in a direct line, and 53½ miles by road. It is 6 miles east of Texas, and 3½ miles from the Severn or Dumaresque River. The main Stanthorpe road runs *viâ* Texas, and is 20 miles longer than the direct short cut from the mine, which the mail coach, running twice a week, now takes. Silver Spur township has a population of something over 200, depending absolutely on the mine, which it now practically encircles.

(*b*) History.

The discovery of copper-stained gossan was made in 1891 by one of the men employed at the Texas Copper Mine. A syndicate was formed, and sunk a prospecting shaft (No. 1) to 70 feet depth, for copper. Soon after the mine was "jumped" and held as a silver mine, the first specimen assayed yielding silver equivalent to 216 oz. silver per ton, the richest yet found. In November, 1892, the mine was purchased, a small company (24,000 shares of £1, paid up to 15s.), was formed, and has successfully carried on operations till the present, when prospects are brighter than at any previous time.

The mine is referred to at some length in Mr. Skertchley's report on the Stanthorpe district, already quoted,* and in an interesting paper by Mr. H. G. Stokes, read before the North of England Institute of Mining and Mechanical Engineers.

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* **G.S.Q. Publication, No. 120.**

(c) MINING.

This mine is unique in Queensland, the deposits worked consiting of huge partly isolated leases. A relatively large amount of dead work is necessitated in exploitation, for though a shaft is sunk on each deposit, it has to be connected with the others for ventilation, exploration, and exploitation, making the total expenses of mining unusually great. The mining costs for the year 1901, exclusive of shaft-sinking and prospecting, were 16s. per ton, the work in the larger stopes costing 7s., and in the smaller 15s.

About thirty men are employed in connection with mining alone, half on the surface and half below, but a far greater number are engaged in wood-cutting, and timber, lime and matte carrying.

Comparatively small shafts (3 by 6 or 9 feet), have thus far been sunk, but the main shaft, now a little over 300 feet deep, in which most of the hauling is done, from between the 200 and 300 feet levels, where the No. 2 and No. 3 ore bodies and those below are being worked, is now being enlarged.

The levels are large, and need very little timber, but in the larger abandoned stopes passages have to be kept open by means of square set timbering. No timbering whatever is required while working in the sulphides.

The importance of prospecting is well understood at this mine, for in several instances new ore bodies have been found by breaking into the country adjacent to the workings; yet, at the present time very little exploratory work is going on. In fact, the main shaft is only a few feet below the 300-feet level, and this is especially surprising in view of the fact that an up-to-date reverberatory furnace is now in course of erection.

(d) OUTPUT.

The anual output of ore is about 4,000 tons, but a steady increase is now expected. At the end of last year (1903), there were 2,000 tons of ore on the surface. The amount actually smelted in 1903 amounted to 3,802 tons, yielding:—

Silver—96,000 oz.	valued at	£8,967
Lead—45 tons	„	517
Copper—31 tons	„	1,798
Gold—147 oz.	„	588
		£11,870

The total dividends to the present amount to £18,618.

(e) SURFACE PLANT.

The winding is done by a 12-horsepower engine, geared to a 4-feet drum, and supplied with steam by a 52-horsepower Babcock and Wilcox boiler. In the same building is a Westinghouse Standard 12-horsepower engine and air compressor, delivering air at 70 lb. pressure to the two rock drills used in the mine. Adjacent to the engine-house is a small sawmill, which has been found necessary, owing to the isolated position of the mine, and has, besides, proved of considerable service to selectors in the district. Near the shaft is a "Giant" crusher, with 9 by 15 inch jaws, worked by its own 10-horsepower engine, and used for crushing the lime and quartz or siliceous ore from the mine used in smelting, the latter when the ore becomes too basic for the furnace—*i.e.*, when the silica contents fall below 20 per cent.

Plate 10.

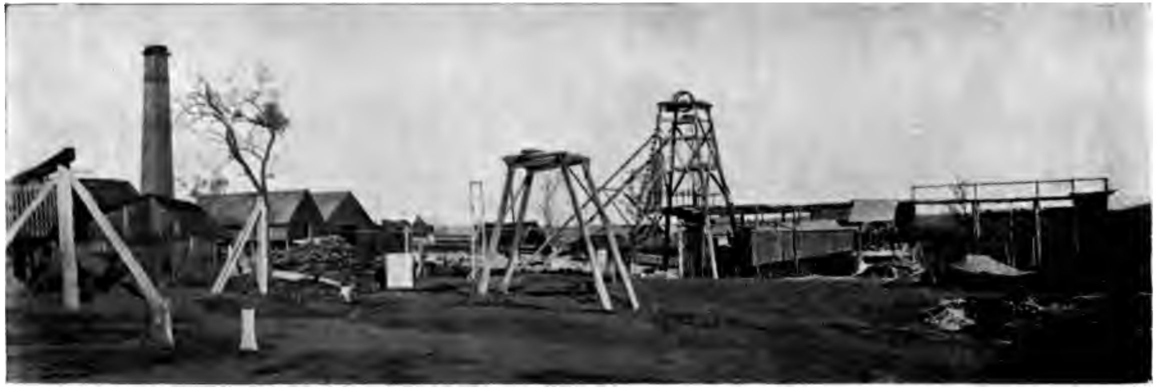

Photo., L.C.B. SURFACE PLANT, SILVER SPUR.

Showing Old Whim, Engine-house, No. 4 Shaft Poppet Legs, Main Shaft Poppet Legs, Rock Crusher, and Grizzleys.

(*f*) GEOLOGY.

The ore bodies occur in beds of dark-grey clay slates, which are interbedded with lighter clay slates, and the occurrence is due to strike faulting or crushing. Sandstones, conglomerates, and limestones, as well as schists and quartzites, occur in other parts of the district, and in some of the sandstones Permo-Carboniferous fossils have been found.* The average strike is north and south, with variable easterly dip. Numerous diorite dykes have been noted, one outcropping within 10 chains of the ore bodies. It is most probable that the ore-bearing solutions were derived from the deep-seated mass of which this dyke is an offshoot.

It has always been recognised that the Silver Spur ore bodies are closely connected with faults. At first it was thought that they were simply bunches attached to one main fault, striking about north-west. This fault is most strongly, or at least most plainly, developed at the north-western end, but towards the south-east it has split up into several nearly parallel branches, and it is difficult to say which is the main one, especially near the main shaft on the 200 and 300 feet levels, where the faults include ore bodies.

Several other faults abut against this main fissure on the south-west, generally normally. These are " strike faults " (the country having a strike of about north-north-east), and along them the country has been replaced by ore, the result being ore bodies. As a general rule the ore bodies are not adjacent to the main fissure in the upper levels, but approach it in depth, and seem there to be developing along it as well as on the fissures at right angles to it.

The main fissure (first found at 45 feet depth in No. 2 shaft), is tight, and never carries water, while the gossans and ore fissures are always saturated when first opened; it is strongly graphitic in places, especially in the central part of the workings and on the 300-feet level. At several places along the fault the country on the southern side is seen to be bent round to the west, near the fault, and therefore the country on the south has been shifted to the south-east, but it is not possible to give the amount of movement, either vertical or horizontal. The main fault was driven on to the south-east from the No. 2 shaft at 60 feet depth, and found to split at 50 feet distance. The country is crushed towards the end of the drive, and work stopped at a strongly mineralised promising-looking " floor," but a drive from the Long Drop shaft to the east is believed to be only 30 feet distant, and proved only a barren fissure.

It was the idea of Mr. Stokes, the former manager, that the fault splits at the 180-feet level, and that the deposits are included between the branches below; the present manager believes that the lower faults do not junction at the 180-feet level, but extend as parallel planes to the surface. There is nothing to support the latter hypothesis. This splitting of the faults has caused considerable uncertainty as to their relations to the ore bodies on the 150 and 300 feet levels, owing to some of them cutting across the bodies.

Ore.—The ore consists of a fine-grained crystalline mixture of galena and blende, with patches and bands of chalcopyrite and pyrite. That the ore has replaced country rock either where thin bedded or crushed (or in other places brecciated), is proved by a section in the drive along the main fault at the 200-feet level, where 2 feet of fissile ore occurs, identical in appearance with the adjacent country.

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* "Ore Deposits of Silver Spur." By H. G. Stokes, Proc. North of England Inst. of Min. and Mech. Engineers. 1899.

Formerly all quartz and quartzose ore were rejected, but the siliceous ore now being got—especially on the 300-feet level, where it contains ruby silver ore (silver sulphantimonide)—is richer than the clean sulphides, and the manager hopes to be able to work out much ore formerly left.

A granite pebble (white quartz, black biotite, pink felspar, and pinite) 3 inches in diameter, was found last year in the ore between the 200 and 300 feet levels in No. 3 ore body. While many of the pebbles found in the slates are due to movement and represent uncrushed country, these granite pebbles, of which several others have been found in the district, have been dropped from floating trees or ice, during the deposition of the sediments.

As the gossan was gradually worked out it was found necessary to work the sulphides, and some surprise was caused by their relatively high silver contents. (*See* analyses below.)

(*g*) Ore Bodies.

It was believed till lately that there were four main deposits, but the work on the 300-feet level has brought to light several additional deposits between No. 2 and No. 3 shafts. One of these bodies is the largest yet found, so the management have good cause to think that there is a bright future before the mine.

Ore Body No. 1.—The prospecting shaft, which is 150 feet deep, was begun on a small outcrop of copper-stained gossan, containing a little native silver. It is vertical to 60 feet, and then underlies steeply to the east to the bottom.

The ore body has now been practically worked out, though there are signs of it again at the 300-feet level. The gossan on the 60-feet level was worked for a distance of 130 feet north and south, with a width of from 5 to 25 feet, strings of ore still running on to the south beyond where worked, apparently well worth prospecting. The average value of the gossan was:—

Silver	30 oz. per ton
Gold	20 gr „
Copper	2·5 per cent.
Lead	5 to 6 „

but assays up to 6 oz. of gold per ton were obtained. The gossan passed into sulphide at 90 feet depth.

At the 100-feet level the average width was 10 feet, and small lenses of ore can here be seen on the eastern side of the face, replacing the clay slate country, while the western wall is slickensided and slightly graphitic. The hanging-wall is generally broken and mixed with ore. A tongue 8 feet wide, of 22-oz. ore, still remains at the south end, and will be worked in the future; 12 feet width of poorer ore (12-oz.) have also been left at the northern end, though it may improve within a foot. A block between the 80-feet and 100-feet levels is the only quantity of ore left in the No. 1 workings. A prospecting drive, known as "Hall's Folly," was carried 100 feet to the north-north-east of the main fault, at the northern extremity of this ore body, in unsuccessful search of other bodies. Much broken country, carrying an ounce of silver per ton, similar in appearance to the highly argentiferous country beside No. 4 body, was met 30 feet north of the fault.

At the 150-feet level the ore was worked over a length of 85 feet and a width of from 1 to 20 feet, but for only 20 feet below the level where it showed signs of "tonguing out." The body was thought to have pinched out here, but miners believe the small body on the 300-feet level is the same. The ore is here broken up by floors dipping south-west, and similar in their occurrence to those in the country north of the main shaft. The sulphides from this body averaged:—

Silver	16 oz. per ton
Gold	1 dwt. „
Silica	26·25 per cent.
Sulphur	27·83 „
Iron	24·57 „
Zinc	11·40 „
Lead	6·46 „
Copper	2·20 „
Manganese dioxide	1·19 „
	100·00

The ore is composed of dense galena and blende with patches and bands of pyrite and chalcopyrite. A slight amount of poor quartzose gossany ore is now being got from the No. 1 body, for fetling purposes in the reverberatory furnace. A few small bunches of ore occur along the main fault between No. 1 and No. 2 ore bodies.

A strange body of ore came in at 170 feet depth, within a few feet of the No. 1 lode, and was followed up from the 200-feet level, on the northern side of the fault cutting off No. 1.

On the 200-feet level, 50 feet north-north-west of No. 2 shaft, a strong formation on a good fissure striking north-north-east has been taken to be the No. 1 body, but in the face of a drive running north-west from the shaft there is now a strong emission of carbon dioxide gas. No. 1 body having been "leady" and gaseous, it is expected that it will be found by continuing the drive.

Ore Body No. 2.—No. 2 shaft, 100 feet east by south of No. 1 shaft, was begun with the idea of striking the No. 1 ore body at a depth, and unexpectedly struck the No. 2 body, which did not actually reach the surface, though afterwards worked to within a few feet of it. It is now 317 feet deep, and used as a main hauling shaft, because of its central position; its dimensions above the 200-feet level are 9 by 3 feet, but below that 11 by 4 feet, the intention being to strip down the upper part when opportunity occurs.

The body near the surface had a length of 65 feet with an average width of 5 feet, while on the 56-feet level it had a total length of 110 feet, with a width of 2 to 10 feet. The southern half was gossan to 80 feet depth, the northern to only 45 feet, the two parts being supposed to be separated by the main fault. The oxidised condition of the southern portion is probably due to the slightly crushed nature of the country there. The slate pebbles found in the ore here may possibly be the harder uncrushed parts of the original country. The sudden variations in the size of the ore bodies is strongly marked on this level, where the ore suddenly increases from 1 or 2 feet to 6 feet in thickness at one of the "floors."

On the 100-feet level the body abuts against the fault, and averages 6 feet in width for 60 feet from the shaft, beyond which the drive was continued 15 feet further south, on formation, with occasional bunches of ore in clay slate. The crushed country to the east carries a little silver. The ore near the shaft is fissile, and the laminæ run in to the south-west (elsewhere they bend to the south-east), and, therefore, there is reason in believing the main fault is not here, but further north. On the southern side of the shaft small lenses have been followed for 100 feet, which, when bearing ruby silver ore, often contain over 40 oz. silver per ton. The numerous lenses, the formation on the fissure, and the black shaley nature of the country, all indicate the presence of another ore body here. A winze sunk to the 150-feet level proved several overlapping lenses.

The No. 2 ore body was not worked below 130 feet depth, though the formation continues, the crushed country 10 feet west of the No. 2 shaft on the 150-feet level being believed to be the same. A formation occurs at the shaft, with veins and lumps of ore, and has been driven on to the south and south-east.

A small ore body, assumed to be No. 2, was struck 40 feet south-south-west of the shaft, on the 300-feet level. It carries from 3 dwt. up to 2 oz. gold per ton.

The country on the west side of the southern portion of the ore body is strongly slickensided.

Ore Body No. 3.—The No. 3 shaft, 240 feet south-south-east of No. 1 shaft, was begun on a small outcrop of gossan 70 feet long and 1 to 8 feet wide, but the large amount of water in the lode prevented exploitation for several years. When the water was finally overcome, the deposit proved to contain some of the richest ore yet found there, and has now, in consequence, been worked out.

At the 50-feet level the body is 100 feet long, and up to 30 feet wide; a strong fissure connects the body with the main fault 100 feet distant. Lenticular masses of quartz, probably older than the ore, occur on the eastern side of the deposit at the 60-feet level. As the ore body pitches towards the north, the southern end passes through the shaft at 90 feet depth at the water level.

On the 90-feet level the ore was 20 feet wide a little north of the shaft, but it gradually contracts to the faulted face, 60 feet from the shaft, where the country is considerably veined with translucent selenite. The country there is a pebble-bearing clay slate, with all the appearance of a "crush conglomerate."

At the 150-feet level ore occurs at the north-east corner of the No. 2 shaft, and also in the shaft, but its relation to the other deposits cannot be seen. The No. 3 body is 130 feet long and 5 feet wide on this level, and is reached by a crosscut from the No. 2 shaft. The ore, 10 to 12 feet in width, has been stoped right to the surface from the level; that underfoot is siliceous, and worth, as far as known, only £2 a ton, but will be made available as a flux, and in working may be found to contain rich ore. A long tongue and several small lenses were followed by a prospecting drive to the south; these lenses of ore occur between the laminæ of the slate, which are themselves often converted into ore, and may be due to the deposition of the ore, for they are not found elsewhere. The drive was carried on along the eastern wall for some distance south of the main body.

Work is now being carried on at 190 feet depth, where there are 10 feet of sulphides, and towards the south 12 inches of clay on the hanging-wall carrying 40 oz. silver. One man during the twelve months prior to October had broken down 400 tons, and is now stoping upwards. The country here is massive grey clay slate; on the east it is shattered, graphitic, and clay-stained.

The ore on the 200-feet level was struck by driving 40 feet south of the No. 2 shaft, when strong gas was emitted by the ore body. The body has quite lately been proved within a few feet of the shaft. Ore has been proved for 40 feet under the 200-feet level. It is 30 feet wide in one place (10 feet of which is poor), but within 30 feet it pinches to 1 foot, and varies from 6 to 12 inches to the winze 160 feet south of the shaft, beyond which the formation still continues. Ruby silver was first found in the northern part of the body here, and 54-oz. ore is still underfoot. A winze 30 feet deep has been sunk on 2 feet of ore near the end, and proves that the ore at that depth is widening towards the north.

The country on this level is strongly graphitic. Some trouble is now found in identifying the main fault on this level, it having formerly been held that it passed within 2 feet north of the shaft, but there is reason for believing that the fault lying 15 feet north of the shaft is the main one, in which case the few hundred tons of ore north of the shaft may be on the usual (the southern) side of the fault. Numerous lenses have been worked out between the 200 and 100 feet levels on the north side of the shaft. A fault running to the north-west from the shaft proved to have several ore bodies on the northern side, one of which, at 50 feet from the shaft, was followed, and led to the discovery of several other lenses.

Considerable prospecting has been undertaken on this level along the fault north-west of the main shaft, in search of Nos. 1 and 4 ore bodies, but only formations were found, the latter gaseous. The formations will be further prospected by drives to the south, as the ore is generally not well developed near the main fault.

A main winze in the central part of the body passes at 240 feet depth out of the No. 3 body into another coming in from the south (the big body on the 300-feet level). The latter is being driven on to the south at the 250-feet level, and is widening out in that direction. The ore is very fine-grained, and contains lenses of graphitic slate. Work is also going on in the No. 3 body, on the same level, showing it to increase from 6 feet on the south to 15 feet on the north, of which, however, 8 feet is zinciferous (45 per cent. zinc). In the face is a strong fissure—the main fault—near which ruby silver occurs in the ore, causing it sometimes to yield 110 oz. of silver per ton. The deposit here has good walls dipping east, that on the western side being strongly slickensided.

The large body of ore on the 300-feet level was struck 50 feet south of the main shaft by a crosscut, which, after passing through foliated carbonaceous clay slate with irregularly folded lumps of calcite, gradually entered highly zinciferous ore, of which there are 10 feet still standing. The "smelter ore," carrying 30 oz. silver, was then proved to be 30 feet wide, but the ore pinched out within 50 feet to the south, though the formation continues, and appears to be increasing in size; the edge pitches south, an unusual thing in this mine. It was not worked northwards towards the fault because its value decreased. The ore is now being shot down from the stopes above already referred to. A crosscut was continued 25 feet to the east, in search of another body, but except water, lime, and ironstains (promising signs here) nothing was found.

Another body of ore was found by following a fault about 20 feet to the north-north-west of the shaft; it contains ruby silver, and is the richest in lead in the mine. Ore is now being broken down here. The same slickensided graphitic fault with foliated country was followed to the south-east, but only small lenses of ore were found. Driving is still being carried on, the large quantity of chalybeate water being a most encouraging sign.

Ore Body No. 4.—The No. 4 shaft, 110 feet north-north-west of No. 1 shaft, was sunk after the discovery, in 1896, of the No. 4 ore body by a drive, a chain in length, along the fault from No. 1 ore body. The ore, the gossan portion of which carried 50 oz. silver per ton, did not reach to within 35 feet of the surface. With the exception of a little sulphide, the body is now worked out. The average length of the body was 30 feet, and the width $3\frac{1}{2}$ feet, but on the southern and eastern side, above the water-level, the broken country for 3 feet from the lode averaged 50 oz. of silver per ton, but contained up to 90 oz. per ton. This argentiferous country was discovered by working away auriferous siliceous flux adjacent to it; and very often it was impossible to tell, except by assay, whether the material was silver-bearing or not.

At the 30-feet level a strong "pug" fault, striking north-north-east, and dipping 1 in 3 to the west-north-west, bounds the deposit on the south. At the south end of the 50-feet level 2 feet of 12-oz. sulphide-bearing country has been left for the present. The change from gossan took place at 80 feet depth. At the northern end the face is 15 feet wide, strongly copper-stained siliceous gossan and sulphide ore, with partly replaced "augen" (ore) slate. Innumerable small irregular bunches and veins of ore pass into the country from this body. The ore pinched to a small vein at 90 feet depth.

Intermittent prospecting with a 1-inch handpower diamond drill is going on for the body on the 150-feet level. The hole (now 8 feet in), is being put in diagonally from the drive on the main fault, 50 or 60 feet from the No. 1 body, to catch the formation exposed 20 feet further along the drive, the hope being that ore may be developed as usual at some distance from the main fault. This formation, which is accompanied by a body 1 to 3 feet thick of sulphide and quartz, bends round, and follows the fault for 10 feet to the north-west. Beyond that the fault continues without "pug," mineral, or graphite, and with no sign of other ore body. Lawson's drive, only 20 feet beyond, struck the fault in a similar condition, so that this end seems least favourable for ore bodies.

This body was never highly zinciferous, but was rich in lead and silver, one lot of 1,000 tons of ore yielding a total of 70,000 oz. of silver.

Shaft No. 5.—The No. 5 shaft, known as the Long Drop, lies 260 feet south-east by east of No. 1 shaft, and is 80 feet deep. A fissure—probably parallel to the main fault of the mine, and 1½ chains to the north—was struck, but no ore was found.

Besides these shafts a main mullock pass, a chain north of the No. 3 shaft, connects the 300-feet level with the surface.

Lawson's Shaft.—This, the only other shaft in the immediate vicinity, is just outside the lease, 200 feet north-north-west of No. 1 shaft. It is 71 feet deep, with a crosscut 20 feet long to the fault on the north. No ore was found here.

A small patch of lead carbonate ore occurred on the surface between Nos. 1 and 4 shafts. It worked out at 30 feet below the surface, where it came against the main fault.

There are rumours of a specimen having been found *in situ* in the early days near where the smelters now stand, and prospecting may yet be done there. A little ore was also found in the north-west corner of M. L. 54, but cut out in the trench.

(*h*) TREATMENT.

The mine being situated on a long slope above the Severn River flats, there has been no difficulty in arranging the surface plant. The ore raised is run in the trucks on an overhead tramway and tipped on to an upper grizzley (1-inch bars with 2-inch spaces), over a second (1¼-inch by ⅜-inch bars and 1-inch spaces). A very small proportion of the fines from the grizzley (3 to 6 cwt. to a charge), is sent to the smelter, a small quantity is spread over the roast heaps, and the greater part goes to a spoil heap, now containing about 1,500 tons, to treat which it is considered a mechanical roaster will be necessary. There have, in fact, been rumours lately of the company undertaking the erection of a roaster for this ore.

Plate 11

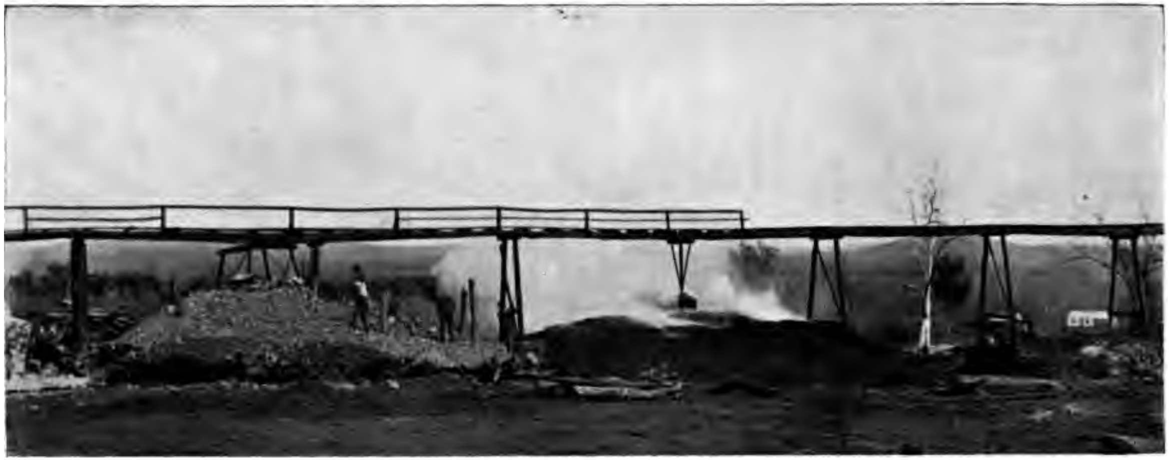

Photo., L.C.B.

ROAST HEAPS, SILVER SPUR.

Showing Heap in Course of Preparation, Heap Undergoing Roast, and Roasted Heap.

Plate 12.

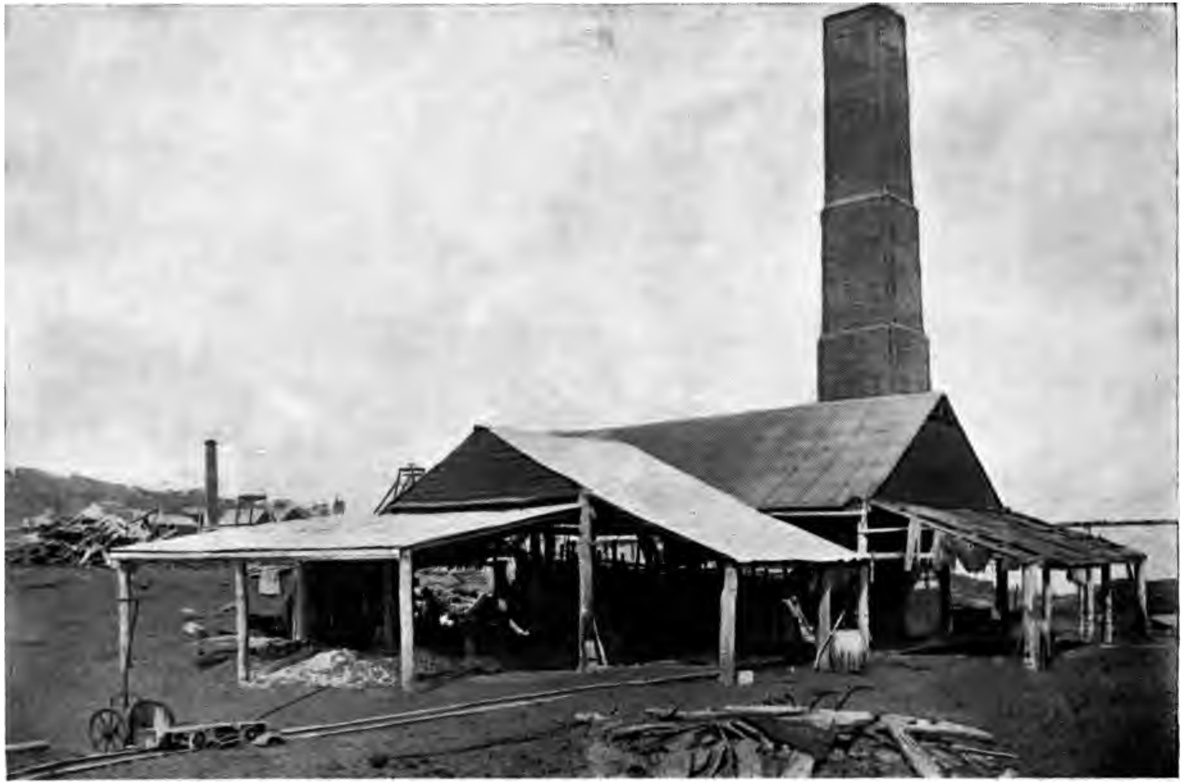

Photo., L.C.B. COPPER REVERBERATORY FURNACE, SILVER SPUR.

SHOWING MINE IN THE BACKGROUND.

Roast.—The coarser and medium ore from the grizzley is then trucked directly along a tramline running over roast heaps, and tipped as necessary. These roast heaps or kilns as they are called, are built up over 2 feet of firewood. The coarsest material (from the upper grizzley), is first thrown down to a depth of 4 feet, and then the ore caught on the second grizzley is tipped and knapped down and spread out by a gang of four men. This is then covered by a thin layer of fines to choke the draughts and prevent fusion of the ore, which is extremely likely to occur, owing to the short time available for the roast. The heaps are 15 yards long, 5 yards broad, and 6 feet deep, and contain on an average 500 tons of ore. Quite lately is has been made the practice to roast the siliceous and basic ores separately, no extra cost being entailed, as the ores generally occur in separate parts of the deposits. One heap of basic ore, containing about 630 tons, was burning during my visit; another of basic and one of siliceous ore had been roasted, and a fourth of siliceous ore was being prepared. The total in the heaps then amounted to 1,500 tons.

The roast takes from two to three months, the sulphur contents being reduced from 28.5 to 14 per cent. Heap-roasting here costs about 2s. per ton of ore (when employing four men on the heaps), and to this amount the firewood (obtained at 10s. per cord) contributes 4½d. When the roast is over it is often necessary to blast down parts of the heap, owing to fusion having taken place.

Reverberatory Furnace.—The roasted ore is carted to the trucks and trammed to the reverberatory furnace, into which it is charged from above. The furnace has a single hearth, and takes a total charge of 84 cwt. (of which 14 cwt. is lime, with an occasional addition of iron ore). This is put through in six or seven hours, making a total of about 15 tons a day. The slags now being produced contain only 2 oz. silver per ton, and the manager is confident that that amount could be reduced by a longer run, which would, however, result in no actual saving.

An attempt has been made to liquate from the old chrome (hearth) lining, when broken up, some of the rich matte absorbed by it; but after the liquation it still contained 150 oz. silver, so an attempt was made to slag off the chromite by the addition of silica. It was found that for the operation to be a commercial success it will have to be done in a blast furnace.

In the operation of smelting the zinc is wasted, but the lead, silver, gold, and copper are saved to a greater or less extent. A parcel of matte shipped in September last ran over 1,000 oz. of silver per ton, and the average content of gold is 1 oz. 6 dwt. per ton (though only a few pennyweights in the ore), amounting to 500 or 600 oz. a year. The following averages of analyses made by Mr. Leon Meston during 1900 are the latest available for the whole process:—

—	Sulphides.	Roasted Ore.	Matte.
Gangue (SiO_2)	14·20	21·43	Trace
Iron	16·14	14·07	5·55
Lead	13·08	10·70	39·30
Zinc	25·30	24·66	2·33
Sulphur	28·50	13·87	19·136
Copper	1·083	1·296	31·50
Alumina, loss, &c.	...	13·974	...
Silver	26·38 oz. per ton	...	1·89
	98·303	100·00	99·676

Later analyses of the ore (also by Mr. Meston) show that the calcium carbonate amounts to less than 1 per cent., alumina to 5 per cent., and arsenic a trace only; also, that during 1900, 1901, and 1902 the amount of silica gradually decreased, the iron decreased nearly 30 per cent., the zinc slightly increased, the lead decreased, and the copper increased very slightly. In connection with the above analyses it may be of interest to give the smelting returns for the year 1901. These have been placed at my disposal by Mr. H. A. Stokes, who was then general manager:—

Ore Smelted.	Flux.	Matte.	Silver.	Gold.	Lead.	Copper.
		Tons.	Oz.	Oz.	Tons.	Tons.
2695·99 tons ...	...	4	2,144	2	1·52	1·29
	72·45	87·55	47,440	59	22	26·5
	1·50	...	@ 2s. 3d.	@ £4	...	@ £55
2695·99 tons	73·95	87·55	£5,337	£236	22	£1,457 10s.

The furnace ran 243 days in the year on heap-roasted sulphide ore. The "matte fall" was 3.36 per cent., and a concentration from 29.73 tons of ore was made to 1 ton of matte.

The total smelting costs for 1901, including superintendence, labour (nine men), fuel, flux, stores, ore carting, freights, and bank and insurance charges, amounted to £1 2s. 10d., the grand total (mining and smelting) per ton of ore raised being £2 7s. 6d.

A new reverberatory furnace is now being erected. The diameters of the hearth will be 15 and 30 feet—area 362 square feet—making it one of the largest copper furnaces in Australia, its estimated capacity being 25 tons a day. The hearth, which has a fall of 6 inches in the 30 feet, is built of a course of firebrick on two courses of ordinary brick, above concrete, supported by three arches, through which a current of air will circulate for the double purpose of cooling the hearth, and of becoming heated itself before admission to the furnace. The roof will be 4 feet above the hearth at the upper end, and 3 feet 6 inches at the lower. The fire grate will be 5 feet in length. The furnace will have three side doors for ravelling, and a tap-hole at the lower end. On the sides where the matte touches will be a lining of chrome-brick, in the making of which a considerable amount of experimental work has been done.

The chromite is obtained from Wyalda, in New South Wales, 35s. a ton being paid for it, delivered at Inverell Railway Station. This involves a train journey of 472 miles to Stanthorpe (at, say, 1d. per ton mile), and then cartage over 50 miles to the mine (at 30s. per ton of back loading, otherwise £2 a ton). The hardest and least friable brick thus far has been obtained by the ignition of a mixture of chromite and talc (?) obtained in the mine, but, as the supply of the latter mineral was soon exhausted, recourse had to be taken to ordinary clay, the best results with which were from a mixture of 75 per cent. chromite and 25 per cent. clay.

Blast Furnace.—A small blast furnace was erected in 1900, owing to the then high price of lead (£17 9s. per ton) to treat the old reverberatory furnace slags, which it has been calculated could be made to pay with the price at £13 10s. By the time the first shipment was ready the price had fallen to £11, and operations were then suspended. The slags, of which there is an accumulation of many thousand tons, contain from 4 to 5 oz. silver, 11 to 14 per cent. lead (the latter from the oxidised ore), and 20 per cent. zinc;

Plate 13.

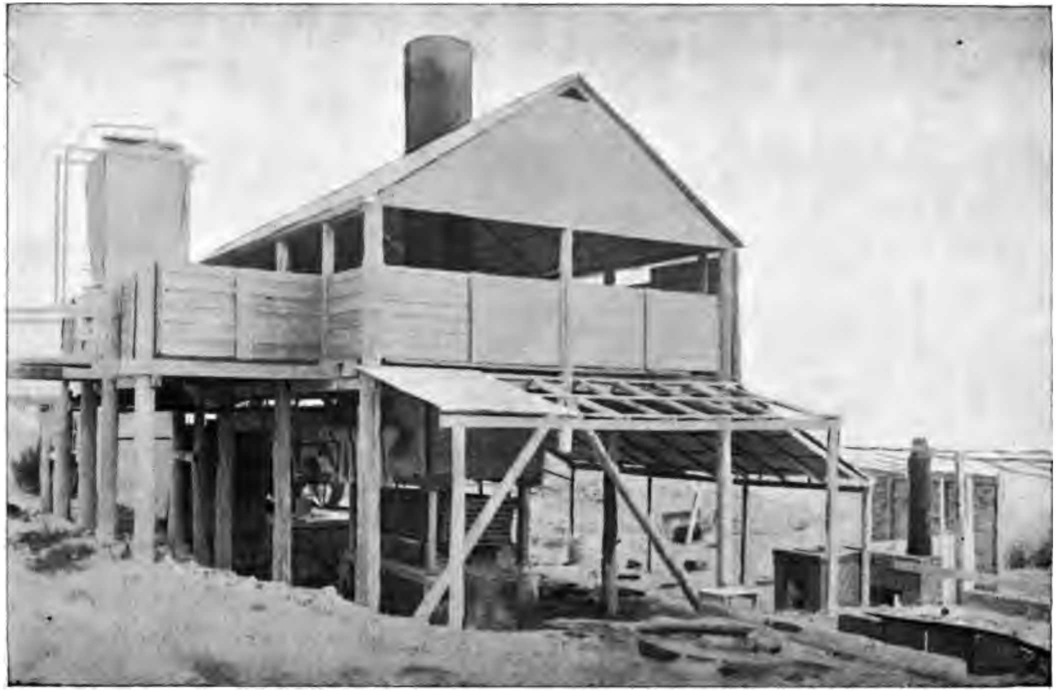

Photo., L.C.B. OLD LEAD BLAST FURNACE, SILVER SPUR.

SHOWING THE BLOWER AND THE SPIRAL TUBULAR WATER JACKET.

3,721 tons of slag, with 21 tons of ore, were put through during 1901 (163 working days), the actual contents being 7.7 oz. silver, 11½ per cent. lead, 14.6 per cent. ZnO, and 34 per cent. Si O_2, requiring 1,414 tons of limestone (at 6s. per ton delivered), and 399 tons of ironstone flux (at 10s. per ton, delivered at works). As a result, 33½ oz. gold, 28,896 oz. silver, 8½ tons copper, and 188½ tons of lead were saved, at a profit up till December, when the market fell.

The furnace contained a novel feature in its water-jacket (Hickson's idea), which consisted of 3-inch iron pipes coated with clay. These pipes were built up in the form of a rectangular spiral for a height of 4 feet above the crucible, and connected with a reservoir overhead. The water used at that time was very impure, and it was found that the lowermost pipes soon became coated internally, and in consequence were burnt through. Mr. Hall proposes as an amendment that the pipes, instead of being all connected in a single spiral, should be built up as separate rings. A number of taps to regulate the flow of water would then be required, but time might be saved in case a pipe had to be removed.

The brick shaft above the jacket is 10 feet by 5 feet in section, and 8 feet high. This is considered too low, and the cause, owing to the small blast, of the comparatively great loss of metal in the slags—viz., 1 to 2 per cent. lead, 16 dwt. silver, and 15 to 20 per cent. zinc. The blower in use was capable of giving 5,000 cubic feet of air per minute at a pressure of 5 lb., but the actual pressure used was from 6 oz. down to 2 oz. There were 7 tueyeres on each side of the furnace.

Another unusual feature of the work here was the use of coal instead of coke, it having been proved to give a cleaner lead slag than coke, and with a consumption only 4 per cent. greater. The coal was obtained from Fraser's Creek, near Ashford, in New South Wales, 30 miles distant from the Spur, a lease being held by the Silver Spur Company. The cartage to the smelters amounted to 25s. per ton. The ash varies from 6 to 20 per cent., and the carbon averages 62 to 63 per cent., though it runs up to 70 per cent. The following section is shown on the company's plan:—

	Ft.	In.
Hard coal (hanging-wall), worked for smelter ...	9	0
Friable coal (white ash), for smithy	9	0
Hard coal	9	6
Shale, with coal bands	8	0
Hard coal	6	6
Coal	1	10
Shale	6	0

The seams dip 1 in 2 horizontal, and have been worked to 52 feet depth.

Coal occurs also at Bonshaw, nearer Silver Spur, but, like the country, it is crushed and contorted, and contains much pyrite.

Pyritic Smelter.—Before opening out on the 300-feet level it was expected that the ore there would be much poorer in silver, and presumably in zinc also, than that above. A modern pyritic blast furnace was therefore installed, but before arrangements were quite complete for making a start, it was found that very little decrease had taken place in the value of the ore, the contents now being nearly 30 oz. silver, 12 per cent. lead, and 25 per cent. zinc. It was then decided not to employ the blast furnace, the reason given being that one-third of the silver would be lost by volatilisation with the lead fumes, owing to the carbonaceous fuel, but the large amount of zinc in the ore must have been a controlling factor.

The furnace included many of the lastest improvements, some of which were looked upon as experimental, and its estimated capacity is from 125 to 170 tons a day. It is circular in section. The crucible is lined for 2 feet from the base with chrome brick, above which is 2 feet of a hollow air-cooled casting, and then 2 feet 6 inches water-jacket, surmounted by a brickwork shaft 5 feet in height. The firebrick-lined tueyeres (Austin's patent), were designed to act like blow-pipes, producer gas (formed in a patent generator consuming wood), being mixed with the blast air at the moment of admission to the furnace. The reducing fusion and most intense action were thus concentrated at the mouths of the tueyeres.

Another special contrivance is the feeding apparatus, also designed by Austin, to obviate premature fusion of the charge at the mouth of the furnace. By it the flux is charged at the circumference of the furnace, and the ore in the centre; the centre is practically gastight, owing to the fusion of the ore. Fumes and gases were to be taken off below the charging floor, and conducted to a settling flue, 1½ chains long and 6 feet across, before passing to the stack.

Fuel and Fluxes.—The immediate vicinity of the mine is now stripped of timber, and the getters have sometimes to go several miles for the necessary material.

The lime for flux and building purposes is obtained from two localities, the one 4 miles east, the other 6 miles north, of the mine. At the latter place ironstone also occurs, and there is good timber in the same direction, but a stiff climb of 400 feet from the mine on to the tableland 2 miles distant, rather handicaps the locality.

On Hughes' selection, 4 miles east of Silver Spur, are two main limestone outcrops. The southern has a width of about a chain, and a length of 2 chains, striking a little east of north. The rock has a bluish colour, and is marked with white veinlets; it assays 94 per cent. calcium carbonate. No mining or quarrying has yet been done, the surface blocks having been simply broken up and carted away. Two other smaller outcrops occur on the same line, within 5 chains to the south, where the country rock is slate, quartzite, and jasperoid. The limestone forms lenticular masses, and has no sign of fossil remains. At the northern occurrence half a mile distant the blocks outcrop on a flat, and are therefore less easy to load than at the southern locality. The company pays 2s. 6d. per ton for breaking the stone and carting it in to the mine.

The limestone area, 6 miles north of the Spur, is at least a mile in diameter, the rock outcropping at intervals over a wide flat, now covered with a dense growth of weeds, rendering it impossible to determine the exact extent. The area includes slates and ironstones.

The main ironstone outcrop is 6½ miles north of the Mine. It consists of three lenticular masses, separated by a few feet; the central is 1 chain long and 10 feet wide, that on the east is 6 feet long and 2 feet wide, that on the west 6 feet long and 3 feet wide. Their strike is north-west. The central outcrop stood 6 feet above the ground, but several hundred tons have been removed from it for flux. The greater part of the ore is brown limonite, but crystalline magnetite is also sometimes found: parts of it are full of grains of quartz, particularly on the eastern side, where it has a brecciated structure.

Calcareous sinter occurs between the eastern and central outcrops, but the country rock cannot be seen because of abundant red soil and thick vegetation.

A shaft has been sunk 10 yards south-west of the deposit, and passes through slickensided clay slates to a depth of 50 feet. It was sunk in order to prospect the lode for copper, because of a few stains on the surface, a crosscut being carried from the bottom to the lode, but a large amount of water coming in the shaft had to be abandoned. Sinking on the ore, though more expensive, would have given some knowledge of the deposit. It is very unlikely that any quantity, more than a unit or two per cent., will be found here. The following is an analysis by Mr. Leon Meston from a 12-ton lot:—

Fe_2O_3	85·22—*i.e.*, Fe = 59·66
FeO	
MnO_2, &c. ...	1·69
Al_2O_3	5·50
SiO_2	4·94
H_2O	2·65
	100·00

The ore cost 10s. per ton, delivered at the works (*i.e.*, 8s. breaking and carting, and 2s. explosives).

In conclusion, I should remark that I am indebted to Mr. E. Hall, the present manager of the mine, for much of the above information, but I am under still greater obligation to Mr. H. G. Stokes, the former manager. It was understood from Mr. Hall that the workings have not yet been surveyed and planned. Until the survey has been made no certain geological work can be done in the mine.

II.—TEXAS COPPER MINE.

Texas Copper Mine lies 2½ miles west of Silver Spur, and was abandoned in 1894, so that the surface only can now be inspected. The country rock is siliceous clay slate.

A siliceous gossan outcrop containing a little copper was first worked. At 60 feet depth the copper ore cut out and work was stopped. A vertical shaft was then sunk on a fissure to the north, and several isolated patches of copper ore were found, but nothing further was done on the main line.

III.—SILVER KING SILVER-LEAD MINE.

Silver King Silver-Lead Mine lies 2 miles north-north-west of Silver Spur, and was opened in 1893. The country rock is "knoten" schistose slate, with lenses of limestone. The outcrop of carbonates of lead and copper in gossan was 30 feet long and up to 5 feet wide, the ore having partly replaced a zone of country rock. There were no defining walls, and the ore gradually disappeared at about 30 feet depth. Ore amounting to 30 or 40 tons was raised and yielded 50 oz. silver per ton, and 5 per cent. lead.

IV.—SILVER CROWN SILVER-COPPER MINE.

This abandoned mine lies 4 miles east of Silver Spur. Small pockets of cupriferous gossan in clay schists, dipping 80 degrees to south-south-east, were found near the surface, but galena and copper pyrite appeared at 50 feet depth. The ore assayed from 5 to 40 oz. of silver per ton, and 14 per cent. of copper.

9th March, 1904.

4.—Appendix.

The following additional notes on the condition of mining at Stanthorpe were made during a short visit at the end of May, 1904.

GROUND-SLUICING, SEVERN RIVER.

Mr. Baker, who at the time of my last visit was preparing to work two claims on the bank of the Severn River, below Ballandean, has informed me that before operations had been going on long enough to prove the ground the lease expired, and as an extension could not be obtained the claims were thrown idle. It is understood that only a small quantity of tinstone was saved.

STANTHORPE PROPRIETARY TIN DREDGING COMPANY.

The following returns are from the Warden at Stanthorpe:—

January to April (inclusive) 1904 ... ... 6½ tons tinstone.

Mr. Martyn informed me that six weeks were lost during the quarter, so that the average output of the dredger per working week was 13 cwt. One shift only was working during that time, but in future three will be kept going.

As the result of this measure of success it was decided to carry out certain alterations, and for that reason the dredger has been laid up since Easter. It is expected that work will not be commenced again before the middle of June.

Among the improvements now being carried out on the dredger is the dropping of the top works (tables, launders, &c.) two feet, allowing the drop-shoot to be carried further under the buckets for the purpose of catching sticky material not thrown out immediately the bucket passes the top tumbler. This will also allow more room on the grizzley, where "Martyn's automatic hoes" are to be employed. The "hoes" consist of half-inch iron plate, hung from endless chain-link belts, and travelling along the bars in the same direction as the "wash," but at a greater speed (150 feet a minute), the object of this addition being to break up the clayey material and force it between the bars of the grizzley.

Another alteration is in the sluice-boxes. Four only will be kept on each side, and these have been lengthened to 15 feet, with ten feet between centres of the rake shafts.

During the last few months two dams have been constructed on Quart-pot Creek, one about half a mile above and the other one and a-half mile above the dredger. A third, half a mile above the last, is now under construction, and it is expected that the three will hold 7,000,000 gallons of water, sufficient to supply the dredger for four months. Before the construction of these dams water had to be obtained by pumping from waterholes in Quart-pot Creek into the Chinaman's race, and the difficulty in obtaining water is held to have been the cause of the smallness of the above output.

It should have been mentioned that Mr. Martyn, who is now managing the dredger, held it on tribute from the company till Christmas last, and it was due to his foresight in keeping on till this year, when stanniferous ground was entered, that the dredger was not dismantled.

BROADWATER PROPRIETARY TIN DREDGING COMPANY.

Two of the dams on this company's leases have been repaired since Christmas, and the dredger has been refloated.

Mr. Martyn has found that the overburden and tailings are practically valueless (contrast with the Brisbane Claim, where two-thirds of the tinstone is in the overburden), and they will therefore be raised and deposited without being passed over the tables. The "wash" will then be raised, and it is expected that two tables will be able to cope with it. The material resembling that at Wylie Creek, the arrangement of the plant will be similar to that in operation there, but the boxes will be longer, and will be provided with mechanical rakes as on the Stanthorpe Proprietary dredger.

PROSPECTING ON FOUR-MILE CREEK.

Prospecting operations have now been completed, and though no word has been received from the principals (Messrs. Gibbs, Bright, and Company), there seems to be every probability of the scheme outlined above being carried out. It may be mentioned that ground carrying one and a-half pounds tinstone to the cubic yard is the poorest that will be worked.

SILVER QUEEN SILVER MINE.

This mine has now been taken up by the Messrs. Baker Brothers, who have pumped out the main shaft to the 100-feet level.

Sixty tons of the ore at grass have just been sent to Aldershot for a trial concentration by Wilfley table. Mr. Baker's own assays of the ore on the surface, after concentrating three to one, average:—

Lead	40 per cent.
Copper	6 „
Silver	64 oz. per ton.

This is considerably higher than the return from my rough surface sample from the same ore heaps, and if correct, with lead at £11 10s. per ton, copper at £56 10s. per ton, and silver at 2s. 1d. per oz., the gross value of the concentrates would be £14 13s. 1½d. per ton. Were the reduction company to pay for both lead and copper, which is not very likely, the smelting charges would reduce this amount by at least one-half (*vide* tariffs), unless special arrangements could be made.

Mr. Baker believes the ore can be mined at 6s. per ton, and crushed and jigged for 7s. a ton, and he puts freight and cartage of the concentrates to Aldershot at £1 15s. In my opinion mining costs would be at least 12s. per ton, making the total cost of a ton of concentrates, delivered at Aldershot, £4 12s.

In case no arrangements can be made with the smelters, it might be possible to save all the metals and receive full value by first extracting the copper by a wet process (for which the ore seems to be specially adapted) and then the lead and silver from the residue by smelting.

2nd June, 1904.

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DEPARTMENT OF MINES.

GEOLOGICAL SURVEY OF QUEENSLAND.
Publication No. 190.

RECORDS.—No. 1.

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II.—NOTES ON THE OCCURRENCE OF GOLD NUGGETS AT THE DEE RIVER, NEAR MOUNT MORGAN.

III.—PHOSPHATE-BEARING ROCKS IN THE ROCKHAMPTON DISTRICT.

IV.—THE IRON BONUS COMMISSION—EVIDENCE TAKEN IN QUEENSLAND.

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LETTER OF TRANSMITTAL.

Geological Survey Office,
Brisbane, 19th March, 1904.

SIR,—I have the honour to forward, for publication as a "Record," Mr. Etheridge's "Notes on the Occurrence of the genus *Halysites* in the Palæozoic Rocks of Queensland, and its Geological Significance," together with other Notes on various subjects by myself.

I have, &c.,
B. DUNSTAN,
Acting Government Geologist.

The Under Secretary for Mines,
19th March, 1904.

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I.—NOTES ON THE TESTING OF CENTRAL QUEENSLAND COAL.

Several tests have been made at various times of the coal in the Dawson-Mackenzie basin, and recently a bulk sample from the mammoth seam, near the Mackenzie River, has been tested by Mr. C. B. MacDonald, the Coal Inspector for the Railway Department. It is stated in his report that the only objectionable feature in the burning of the coal is the formation of clinker and some incrustation in the end of the tube in the firebox. He also states that the coal ignites readily and burns brightly, radiating heat well, and emitting no smoke when properly fired.

The tabulated results of the test, amongst other data, indicate that in one trial 1 lb. of coal evaporated 9.4 lb. of water at 212 degrees Fahr., and that in another trial 1 lb. of coal evaporated 9.7 lb. of water under similar conditions. These results are eminently satisfactory, and compare favourably with the English Admiralty tests of Welsh coals, which indicate, under similar conditions, that on an average 1 lb. of Welsh coal evaporated about 9 lb. of water. The highest results in the tests was obtained from a coal which evaporated 10.7 lb. of water, but a great number of good Welsh coals did not evaporate even 9 lb. of water.

Coal from the Bluff has also been tested by the Railway Department, but Mr. Graham, for whom the tests were made, states that the results were not satisfactory owing to the coal being taken too close to a disturbed area, but that it is intended to proceed with the development of the mine, and to have a bulk sample taken from the seam further away from the disturbance.

Coal from the Central Queensland Coal Syndicate's mine on the Dawson River has been tested by the Admiralty authorties in Sydney, the results of which are given in the following table:—

RESULTS OF TRIAL ON H.M.S. "WALLAROO."

H.M,S. "WALLAROO," AT JERVIS BAY, 29TH DECEMBER, 1903.

—	Anthracite only.	Equal proportions Anthracite and Osborne Wallsend. Forward stokehold.	Anthracite only. Aft stokehold.
Date of trial	7 p.m. to 9·30 a.m., 27-28/12/03	9·30 a.m to 7 p.m.	9.30 a.m. to 7 p.m.
Duration of trial	14½ hours	9½ hours	9½ hours.
Average speed	12·54	12·64	12·64
Coal per hour	44·2 cwt.	16·75 cwt.	27·6 cwt.
Average coal used per I.H.P. ...	2·7 lb.	2·05 lb.	3·2 lb.
Distance run per ton of coal ...	5·6 knots	5·4 knots	5·4 knots.
Revolutions per minute	Sd. 105·48, Pt. 104·4	Sd. 108·8	Pt. 108·29.
Average I.H.P.	1,827	1,827	1,827.
Rate of combustion	Moderate	Moderate	Moderate.
Deposit of soot in tubes	Very slight and of gritty nature	Very slight and of gritty nature	Very slight and of gritty nature.
Emission of smoke (see remarks) ..	Slight	Slight	Slight.
Grate surface in use	1,508	754	754.
Percentage of ash and clinker, approximate	8·4	9·87	10·41.
Maximum temperature of coal boxes under similar conditions	90	90	90.
State of ship's bottom	Fairly clean	Fairly clean	Fairly clean.
Draught of water at beginning of trial	17 ft. 8 in. aft, 16 ft. forward	17 ft. 8 in. aft, 16 ft. forward	17 ft. 8 in. aft, 16 ft. forward.
Force of wind	4 to 5	4 to 5	4 to 5.
State of sea	Moderate	Moderate	Moderate.
Direction of wind relative to ship's course	On beam	On beam	On beam.
Consumption per square foot of grate surface per hour	3·28 lb.	2·5 lb.	4·1 lb.

~~589772~~

REMARKS.

(1) Trial satisfactory.

(2) Conditions:—

Nos. 1 and 2 boilers lit up with the anthracite coal; Nos. 3 and 4 with Osborne Wallsend.

In No. 1 boiler one fire-bar was removed from each tier, and fires were lit 12 hours before steam was required for moving.

In No. 2 boiler fires were lit under normal conditions 10 hours before steam was required.

Steam was showing in No. 1 boiler (sufficient to start circulators) in 6½ hours. Steam for connecting up No. 2 boiler was ready in 11½ hours.

As soon as ship was clear of harbour, Nos. 3 and 4 boilers were fired with anthracite coal only, and trial started at 7 p.m.

All draught plates were removed, and steam was regulated by the fan engines, the air pressure varying from three-tenths to five-tenths.

Fires were gradually thickened to about 6 inches, and kept level by using a rake.

It was seldom necessary to use the pricker excepting in the far corners when fires looked dead from ash-pits.

The flames never extended more that 1 to 1½ feet over the surface of the fire.

After steaming for 14½ hours with anthracite coal in forward boilers, an experiment was tried with mixing the anthracite and Osborne Wallsend in equal proportions, with the attached results.

The aft boilers were steamed with anthracite coal only throughout the 24 hours. At the completion the fire-bars were covered with a deposit of white, powdery ash, easily removed, and little clinker.

The clinker found was of a solid nature, 1 inch to 2 inches in thickness, which was easily removed, as it was of a brittle nature.

Details of smoke were taken from the bridge each hour during the night. and its density varied from 0 to 1.

When the mixing of coals was taking place details were taken each quarter of an hour from each funnel, and comparisons made.

They varied from 0 to 2, and from the general result the emission of smoke was practically nil.

Jno. E. Hewitt, Captain.
Hamilton J. Coad, Engineer-Lieutenant (Ringarooma).
W. H. Glasspole, Engineer-Lieutenant (Wallaroo).

SUGGESTIONS BY ENGINEER-LIEUTENANT COAD.

As this coal is of a non-coking nature, its general adoption by itself would appear impracticable, as it is only possible to burn it under very limited conditions. From past experience with anthracite coal, it is found impracticable to force it over ½-inch air pressure, and likewise it is absolutely necessary to use the fans while burning it. From the results obtained, it would appear an excellent addition to the ordinary volatile Australian coal if mixed in proportions of about three of Australian coal to one of anthracite; for it is inferred that the former would aid the complete combustion of the latter, and in the process of combustion a large proportion of smoke would be eliminated.

From the burning of this anthracite coal, it would appear to be of much the same nature as that which is obtained from South Wales, England, although its chemical analysis, as supplied, does not agree. This may easily be accounted for by the fact that the analyst does not determine his results in the same way as is adopted in the Admiralty Laboratory at Cardiff.

The following remarks on the test were submitted to the Under Secretary by myself:—

"A review of the above table and notes thereon shows that the question of the Dawson coal being smokeless may now be dismissed, as it has been finally and authoritatively answered in the affirmative.

"Regarding the combustion of the coal, there appears to be no doubt that it is rather slow to ignite, and this must be taken as an objectionable feature. The percentage of ash and clinker is satisfactorily low in comparison with that of high-class Australian coals, the latter sometimes reaching double the amount shown in the above table.

"The crucial point about the test is the quantity of coal required to produce a certain amount of steam in a given time. The amount of coal used in the Dawson test is very low, but I am of opinion that even better results can be obtained when the peculiarities of the coal are understood. The engineer-lieutenant states, in effect, that the coal would reduce the tendency of other Australian coals (which under Admiralty conditions are inferior) to make smoke if burned with them; and as New South Wales coals could be obtained more conveniently and cheaper than Dawson coal in the Dawson-Mackenzie coal basin, no doubt the Admiralty would welcome any coal of special quality which would help to burn the coals they can so easily and cheaply acquire.

"So far as the Central coals are concerned, two classes exist, and if it be necessary to mix the Dawson coal—which, by the way, is distinctly and decidedly not an anthracite—with a more bituminous coal, this later class of coal can be supplied either from the Mackenzie River coal or from the Bluff on the Central railway, both producing a more or less caking coal. Indeed, I am of opinion that the coal from the Mackenzie and the Bluff would in themselves produce results similar to a combination of the Dawson and southern coals. I would therefore suggest the next stage in determining the qualities of Central Queensland coal should be to have a trial of the Mackenzie or Bluff coal under similar conditions—preferably the Mackenzie.

"The conditions laid down by the Admiralty, briefly stated, are as follow:—

To generate steam quickly the coal should burn quickly. Water should be converted into steam with a small consumption of the coal.

The coal should not be "bituminous," as such coal makes smoke, and this is objectionable.

The coal should be dense and not friable, to stow compactly into bunkers, and not to break up by movements of the vessel.

It should be to some extent a caking coal, so that the particles cohere when in the furnace—an advantageous quality when a vessel is rolling in a gale.

No coal in the world is known to possess all these qualities."

Judging from the manner in which the word "anthracite" has been used recently, there seems to be a misconception regarding its application. Even in works of reference considerable confusion exists as to how it should be applied. The percentage of fixed carbon is constantly but incorrectly being used as a basis to determine whether a coal is or is not an anthracite. A coal high in fixed carbon (say, 90 per cent.), and another one with, say, 60 per cent., might each be a true anthracite, although between them there is a difference of 30 per cent. of fixed carbon. Of coals having a low percentage of fixed carbon, an example may be given of one occurring at Hampden, north of Mackay, the composition of which is as follows:—

Moisture	2·4	per cent.
Volatile Hydro-carbons	2·2	,,
Fixed Carbon	65·8	,,
Ash	29·6	,,

The analysis shows nearly 30 per cent. of ash, and the coal is practically useless; but it has every anthracitic feature, including a *very low percentage of hydrocarbons compared to that of fixed carbon.*

The ratio of hydrocarbons to fixed carbon is the important factor in the determination of an anthracite, and as a result of this it is found that, roughly, a coal with less than 10 per cent. of hydrocarbons may be considered an anthracite, while with a slightly higher percentage it would be a semi-anthracite or semi-bituminous coal. An increasing quantity of hydrocarbons graduates it into ordinary bituminous coal.

The amount of fixed carbon is also commonly taken as the basis of the heating power of coal, but a coal may be low in fixed carbon and at the same time produce more heat than an anthracite. This is because of the heat-producing element in its volatile hydrocarbons. Hydrocarbons contain hydrogen, and if there is any available for combustion, which is not always the case, one per cent. of it is found to be equivalent to 4½ per cent. of carbon. A coal therefore having 80 per cent. of fixed carbon and two per cent. of "available" hydrogen in its hydrocarbons would have nearly as much heating power as a coal with 90 per cent. of fixed carbon and no available hydrogen, while a coal with 75 per cent. of fixed carbon and four per cent. of available hydrogen would have a greater heating power than either of the above. New Zealand Westport coal, for example, is not an anthracite but a bituminous coal, having a heating power greater than many other coals which have much more fixed carbon in their composition, this greater heating power being due to the available hydrogen in the volatile hydrocarbons.

In the results of the recent Admiralty trials of Queensland coals no information is given concerning their calorific value. This is to be regretted, as it is as necessary to know how much heat energy is contained in the coals, and how much is being wasted, as it is to know how much is being utilised.

No systematic investigations have been made to determine the economic value of Queensland's resources in coal. The matter is one of increasing importance from a commercial standpoint, and an examination should be made of all the coals of the State. The results should be tabulated and put in a form available to both producer and consumer.

The examination should comprise a number of tests; but the principal ones would be—(1) Chemical analysis, (2) Calorimetric tests, (3) Practical working tests in marine and locomotive engines, (4) Its coke-making properties, and (5) Its suitability for making gas for lighting and heating purposes.

The commercial aspect must not be forgotten, and amongst other things should take into consideration the behaviour of the coal in transit, its liability to spontaneous combustion, the question of convenience to port, and freedom or otherwise of consumption in fireboxes.

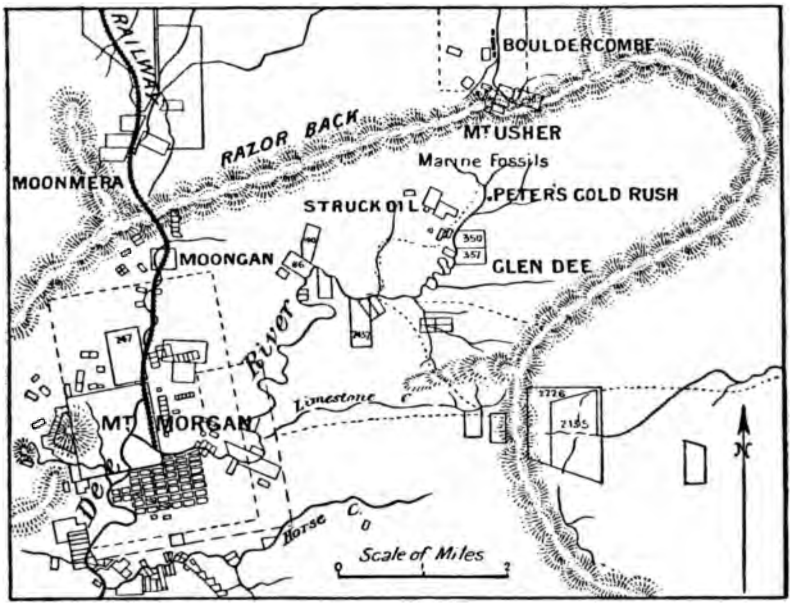
II.—NOTES ON THE OCCURRENCE OF GOLD NUGGETS AT THE DEE RIVER, NEAR MOUNT MORGAN.

◆

An inspection on 18th December last was made of the workings on the Dee River, where recently a large number of slugs of gold have been unearthed. The locality is about 4½ miles from Mount Morgan, in a north-easterly direction, and in the vicinity of Mount Usher, as shown in the following sketch plan:—

SKETCH PLAN.

Showing Locality where Nuggets are being found on the Dee River.



The river was in flood at the time of the visit, and many of the workings could not be examined; but sufficient data was obtained, from an inspection of the workings which were not flooded, and also from the workmen, to show the manner in which the gold occurs in the wash, and how it came into its present position During the time of the examination a nugget weighing 85½ oz. was found in one of the claims, and a careful inspection was made of the spot to obtain all the information bearing on its origin.

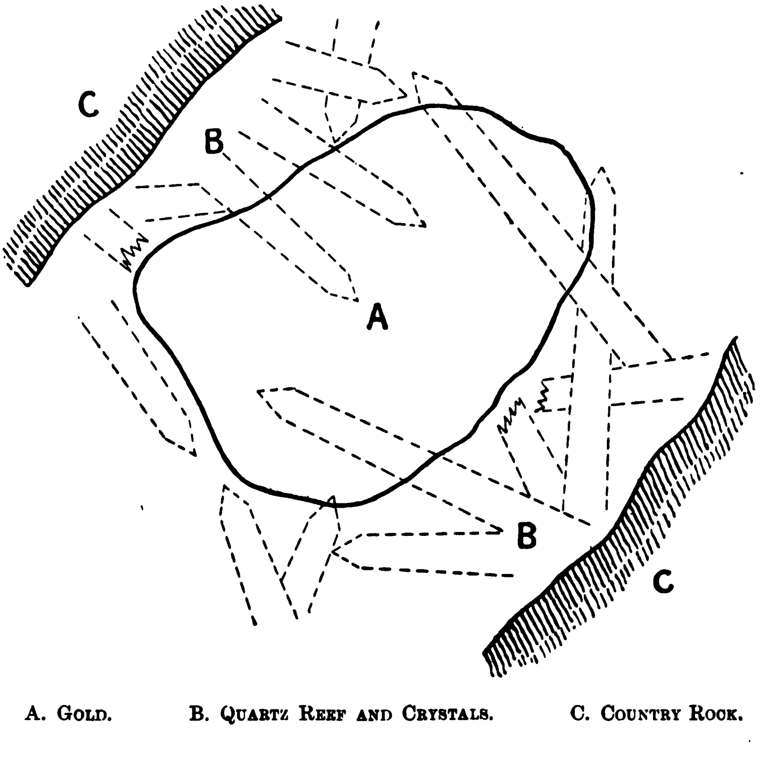
All sorts of theories had been suggested to account for the gold occurring in such coarse pieces, but nothing was seen different to the usual mode of occurrence of alluvial gold. Some of the miners had an impression that the gold was formed in a "mullocky" leader in the adjacent country rocks, and had been washed down to where now it is being found. Others were of the opinion that the gold had been formed into nuggets in the alluvial deposits, or that small pieces had become enlarged by the precipitation of gold on their surfaces.

The latter view was held by a great number of persons because of the frosted appearance of many of the nuggets, and who considered that the alluvial gold, to become frosted, must have received some increment by the precipitation on its surface of gold held in solution. This, of course, need not be so, and the frosted appearance may be, and probably is, due to the action of percolating mineral waters, by which the surface has been etched.

The idea that gold was formed in a "mullocky" leader also had a number of advocates, but the evidence on this point showed conclusively that the gold had formed in association with quartz. The 85½ oz. nugget, on examination, besides showing a frosted surface, was found to be penetrated by a number of six-sided holes. On closer inspection, after the specimen was cleaned, these holes proved to be the casts of quartz crystals, in which all the well-known peculiarities of crystallisation of that mineral were reproduced, showing undoubtedly the gold to have been deposited in a vugh or cavity containing a cluster of quartz crystals. The following rough sketch will show how the gold occurred, and from it the conclusion will be drawn that the size and shape of the gold nuggets were very different when enclosed in the cavity of quartz crystals from what they were when found in the alluvial wash, after being worn into their present form by attrition:—

DEE RIVER NUGGET.

Sketch showing Casts of Quartz Crystals in the Gold, and probable position of the Gold in the Reef from which it was derived.



A. Gold. B. Quartz Reef and Crystals. C. Country Rock.

It may naturally be assumed that a cavity or vugh of quartz crystals occurred in a reef of quartz, and that the reef has been gradually weathered away by the ordinary processes of sub-aerial denudation; and while the gold was being washed away from the reef and lodged in alluvial deposits, the alluvial deposits or "wash" was forming by the accumulation of detrital material derived from the reef itself and from the country rock in the vicinity.

There is very little hope of finding the reef which contained the gold, as many changes have taken place in the configuration of the country since that time; and if a reef containing very rich gold were discovered close by one would be very much inclined to think it had quite an independent existence to the reef from which the gold recently found has been shed.

The prospect of finding a continuation of the lead above or below the present workings is a matter of concern to the miners; and, although further discoveries of gold may take place, no favourable feature was observed during my short visit to indicate any great extension of the field. The confined space between the hill in which the lead occurs and the disturbance of old leads by recent encroachments of the stream, together with the formation of recent deposits from old ones, are considerations which make it impossible to determine the direction of the lead in which the gold has been deposited, until the gold has been actually found. The information which might have been obtained from a longer inspection cannot be conjectured; but, while nothing was observed to indicate the permanence of the field, the character of the rocks in the country round about shows that similar deposits might be found having no connection with this one on the Dee River.

A quartzite formation in the vicinity has been found to contain gold, and was thought by the miners to have some connection with the alluvial gold found in the bed of the river. This formation is not a reef, but an altered sedimentary deposit impregnated with gold-bearing pyrites, and consequently has quite a distinct origin to a quartz reef in which such massive gold specimens were formed.

Mention may also be made of the character of the bed-rock on which the gold has been found, in view of the opinion expressed that it might have been the matrix of the gold. In many of the claims the bottom of the wash is a clay, in which some of the gold nuggets were partly embedded, while in other places the bottom is a decomposed shaly sandstone rock. In the decomposed bed-rock some fragments of marine fossils were discovered, which indicated the strata here to be "Gympie" formation of Permo-Carboniferous age. The surrounding country appears to be made up of a variety of rocks of similar formation with intrusions of acidic and basic igneous dykes.

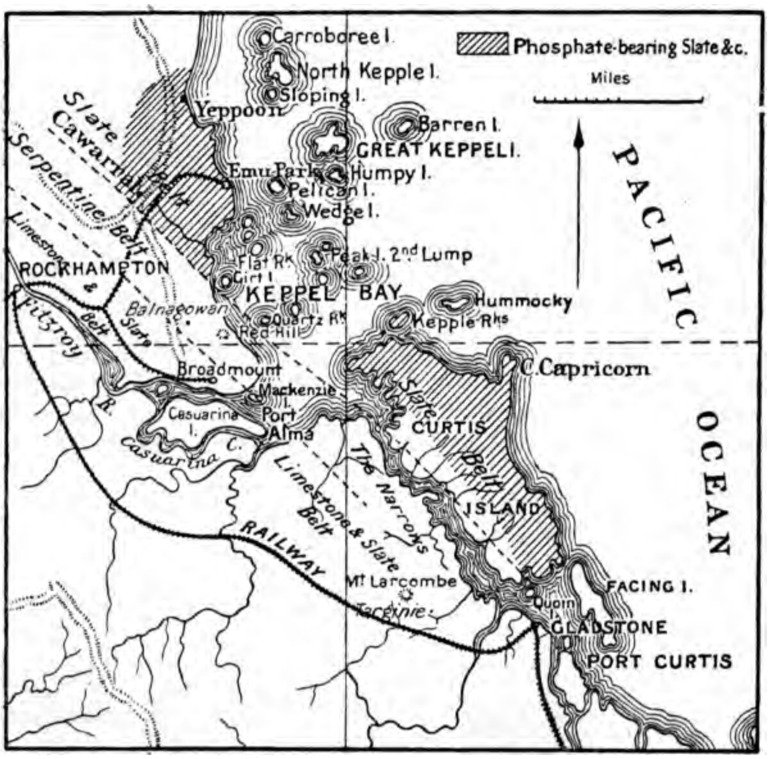
III.—PHOSPHATE-BEARING ROCKS IN THE ROCKHAMPTON DISTRICT.

◆

Reference was made in the Progress Report for the year 1897* to the presence of a phosphate of alumina in the altered slates at the mouth of Cawarral Creek and on the islands of Keppel Bay. Since that time the advantage of knowing more about phosphatic deposits has induced further attention being paid to their occurrence, and the results of an examination of other islands and of the mainland on this part of the Queensland coast shows that phosphates, in association with altered slate rocks, occur at Emu Park, Yeppoon, Curtis Island, and Quoin Island to the south of Curtis Island. These localities are shown in the following sketch map:—

KEPPEL BAY AND ENVIRONS.

Showing Position of Serpentine, Limestone, and Slate, and Phosphate-bearing Slate Belts.



The slate country seems to occur as a belt trending north-west and south-east, and extends from Facing Island to beyond Yeppoon. The rocks in this belt consist of ferruginous, clayey, and quartzose slates, which are more or less altered and contorted, and contain masses of chert and quartz, while in places they are traversed in all directions by fine quartz leaders. The phosphates occur usually as apatite, the yellowish and brownish lime phosphate; but turquoise, the bluish and greenish alumina phosphate, is also occasionally found.

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* Annual Progress Reports for the years 1896–1898. Brisbane: By Authority, 1899; pp. 14 and 16.

The deposits on Keppel rocks were prospected by Mr. E. K. Ogg, of Rockhampton, and from a quantity of phosphate rock in his possession the writer took an average sample for analysis. This yielded at the rate of 14 per cent. of phosphoric acid, being an equilavent, roughly, of about 40 per cent. of lime and alumina, the result not being considered satisfactory. The sample, however, is from one of a number of places along the coast where phosphates are known to occur, and encourages us in the hope of finding something better.

At Quoin Island Mr. Ball has found turquoise as small irregular masses and veins in ferruginous and quartzose slates, but the occurrence of other phosphates was not noticed.

At Olsen's Caves, about 16 miles in a northerly direction from Rockhampton, an investigation has been made to determine the extent and richness of the bat guano deposits known to exist there. An illustrated description of the caves has been published by Mr. J. Christensen, Danish Consul,* showing the possibilities of making the working of the deposits a profitable undertaking. Some exploratory work has been carried out under his directions, showing that the deposits were extensive, and contained in places pure phosphate of lime, but the results were not encouraging, and work was suspended. Every endeavour should be made to have the cave deposits thoroughly prospected in view of the value a good deposit of bat guano would be for agricultural purposes.

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* Olsen's Caves, near Rockhampton. By J. C., in Q.G.M.J., 1903, p. 572.

IV.—THE IRON BONUS COMMISSION—EVIDENCE TAKEN IN QUEENSLAND.

The Royal Commission on the Federal Bonus Bill held three sittings in Brisbane on 1st and 2nd May, to take evidence bearing on the occurrence of iron ore deposits in Queensland. Those examined were Captain Richards, general manager of Mount Morgan; Mr. W. Fryar, Chief Inspector of Mines; Mr. L. C. Ball, Assistant Government Geologist; Mr. J. Hargraves, mining surveyor of Ipswich, and myself.

The information accumulated by the officers of the Geological Survey was obtained under difficulties, but most of the localities have been visited where minerals used in the production of iron are known to occur, and the results of these inspections was of the greatest value for the purpose in view. The report of the Commission has been published, and a reprint appears in the *Government Mining Journal* of 14th November, 1903.

It is only since the inquiry that public attention has been drawn to the natural facilities possessed by Queensland for iron manufacture, and the almost boundless resources in iron, coal, limestone, and other accessory minerals on her eastern seaboard. A perusal of the accompanying plan and table will show the locality of some of our minerals, and their position with regard to centres at which works might be started.

The following is a summary of evidence taken by the Iron Bonus Commission at the Brisbane sittings:—

SUMMARY OF EVIDENCE.

The Federal Royal Commission, appointed to inquire into the question of the proposed establishment of the iron manufacturing industry in Australia by means of a Government bonus, held three sittings in Brisbane—two on the 1st May and one on the 2nd. The Commission had previously taken evidence in Melbourne and Sydney, and the sittings were held here during the recent visit to Queensland of its Chairman (Hon. C. C. Kingston, Federal Minister for Trade and Custom). Besides Mr. Kingston, the other members of the Commission present were: Mr. L. E. Groom, Federal Member for the Darling Downs (Q.) and Mr. David Watkins, Federal Member for Newcastle (N.S.W.). Appended is a summary of the evidence taken:—

Mr. Dunstan's Evidence.

Benjamin Dunstan, F.G.S., Acting Government Geologist, of Queensland, examined by Mr. Kingston, stated that he had been in the employ of the Queensland Government for the past six years. Asked as to whether he had formed an opinion as to the prospect of the successful establishment of the manufacture of iron and steel in Queensland, he said he had formed an opinion on that subject as far as it related to the deposits of iron, limestone, coal, and other minerals necessary for that purpose. From the quality, locality, and extent of the iron ore and coal deposits, as well as the availability of fluxes, he was satisfied—indeed, had no doubt in his mind—as to the prospect of successfully establishing such an industry in this State. From a commercial point of view, he could not express an opinion, but as far as the requisites for the manufacture of iron were concerned, it seemed to him there was everything that could be desired. The materials that were needed were readily accessible, in some districts were within a short distance one from the other, and from this point of view everything was in favour of the successful establishment of the iron industry. There were many large deposits of iron known to exist in Queensland. He had prepared a plan and table showing some of Queensland's ironstone, coal, and limestone resources (which he tendered to the Commission). This diagram included deposits within a reasonable distance of the eastern coast, and gave details of their locality, extent, and the quality of the ore. There were other deposits, but they were not convenient to the seaboard, and he would give particulars of those not included in the diagram. The particulars given in that diagram had been carefully checked in his office, and could be relied upon as being correct.

Speaking of iron ore, Mr. Dunstan said there were a great number of deposits in Queensland. Particulars had been prepared altogether of about a dozen. There were a number shown on the map representing the eastern coast of Queensland, and in addition to these there were others not shown. These latter occurred inland, and comprised Mount Leviathan, Kangaroo Hills, Wild River, and Mount Lucy, all containing valuable deposits of ironstone. Mount Leviathan was at Cloncurry, 250 miles from Normanton (on the Gulf of Carpentaria), 210 miles from Winton, where coal occurred, and 550 miles south-west from Townsville. Normanton was the nearest port. The nearest railway was at Croydon, but a railway from Cloncurry would be most likely to go to Normanton direct. In the same locality as Mount Leviathan there was abundance of limestone, and at Cloncurry there were immense deposits of copper. As to the extent and quality of the iron ore deposit at Mount Leviathan, Dr. Jack (late Government Geologist), in Bulletin No. 10 of the Queensland Geological Survey Publications, said that the hill consisted of "a mass, say 200 feet high, and a quarter of a mile in diameter at its base, of the purest possible iron ore The greater part of it is massive or granular iron ore, with only a few grains of siliceous sand. Specimens of foliated specular iron may be picked up, and parts of the mountain are of magnetite. The specular iron is frequently magnetic." As to the quality of the ore, he had no analysis further than that obtained by Dr. Jack, but it would be observed that he described it as "the purest possible iron ore." As to the quantity, taking the height as 200 feet and the diameter 1,200 feet, and without going below the base of the mountain, they had 10,500,000 tons of hæmatite. In the same locality was a smaller hill—Mount Pisa—of one-tenth the capacity of Mount Leviathan, which would practically give another 1,000,000 tons—or a total of 11,500,000 tons. The two mountains were two miles apart, and possibly were connected by subsidiary deposits which outcrop in various places between them. Mr. Cameron, Assistant Government Geologist, in the notes already presented to the Commission, had given particulars of these deposits. (See *Government Mining Journal*, March, 1903, p. 126). He (Mr. Dunstan) had seen a private letter from Dr. Jack, who was now in London, in which he reiterated the description which he had previously given of these Cloncurry deposits. With regard to Kangaroo Hills, a report had been made on this as a mineral field, but Mr. Ball, Assistant Government Geologist, who was also to give evidence, would give a review of it later on. The information available concerning the deposit on the Wild River was from a report by Dr. Jack. As to its position, it was 80 miles directly south-west of Cairns, and was reached by rail to Mareeba, 46 miles, and thence 60 miles, *viâ* Herberton, by road. In a report written in October, 1898, Dr. Jack had described this deposit as "a large lode of pure magnetic iron oxide." Mount Lucy was about 80 miles south-westerly from Cairns on the Chillagoe Railway This also had been reported on by Dr. Jack in a "Report on the Chillagoe Mining District and

Projected Railway" (Bulletin No. 9, Geological Survey of Queensland, p. 16). He states that "On the top of this hill is an enormous outcrop of exceedingly pure magnetite," and that "the purity and abundance of the ore of Mount Lucy cannot be questioned."

Limestone deposits, Mr. Dunstan stated, were found at Mortar Island, Marble Island, Mackenzie River, Mount Etna, Fitzroy River, and Cloncurry. Mortar and Marble Islands were opposite Broadsound, 40 miles north-east of St. Lawrence, 150 miles north from Keppel Bay, Broadmount, and Port Alma. On Mortar Island there was an inexhaustible quantity of the purest limestone. The information he had obtained regarding this deposit was the result of practical working tests by Messrs. James Campbell and Sons, of Brisbane. This was to the effect that it contained 98 per cent. of carbonate of lime, while the stone was, in places, a beautiful saccharoidal marble, and free from clay and silica. Boats loading 500 tons could be comfortably berthed alongside the island, while a jetty could be very easily made to ship stone. Mr. Campbell had given him an approximate estimate that, with a jetty constructed, limestone could be shipped on board a vessel at the island for 2s. per ton. The Mackenzie River deposits of limestone occurred close to the junction of the Isaacs and Mackenzie Rivers, and within 60 miles of the St. Lawrence. If a railway were constructed from the Mackenzie River coal beds to St. Lawrence, it would pass through these limestone deposits. As to the quality, it was siliceous, but the deposits were not explored at the time, and probably places could be found where the limestone was free from silica, as here the silica only occurred where the limestone was fossiliferous. The limestone deposits at Mount Etna, near Rockhampton, were practically inexhaustible. No analysis had been made of it, but large quantities had been used for lime-making for a great number of years, which was a pretty good indication that there was not too much impurity in it. The deposit on the Fitzroy River was 200 yards from the bank of the river, and about four miles north of Rockhampton. The analyses showed a high percentage of carbonate of lime, but the analysis was not complete. Magnesia was present, but the percentage has not yet been estimated. As to the Cloncurry limestone, Mr. Ball was making some extracts from the official reports, and these would be submitted later on in the sitting.

Witness next spoke of the coal deposits of the State. Asked what were the chief deposits, he said there were the Styx River coal, the Mackenzie River coal, the Dawson River coal, the Callide Creek coal, and that of the Burrum and Ipswich districts. These were on the eastern coast, and low down on the coast, but there were other deposits further north and inland which had not been investigated. Asked as to whether there were any recent discoveries of coal, Mr. Dunstan said there were semi-anthracite deposits on the Dawson and a highly bituminous coal deposit on the Mackenzie River. The official tests which had recently been made of the Dawson coal showed that it was anthracitic in quality, and was non-coking; but the test that had been made of the coal away from the banks of the Mackenzie River submitted to the Mines Department by the Mammoth Coal Company, working at the Mackenzie River, indicated that the whole of the 20-feet seam is not an anthracite, but a coking coal of magnificent quality, having a very small percentage of ash (6.5), and a very high percentage of fixed carbon (77.5). The best coal for iron smelting was undoubtedly a coking coal, producing a firm coke, but anthracitic coal was also very valuable for the same purpose. Practically it had been found that anthracite could be used for iron smelting, and in America immense quantities of iron were produced with the use of this coal. The Geological Survey records showed that at the Styx River there were 150 square miles of coal country. These records were contained in a report (No. 84) by Mr. Rands, late Government Geologist, on the "Styx River Coal Field." An analysis from one seam seven feet thick showed 11 per cent. of ash in the coal, which made a firm coke. A 15-inch seam showed 3.8 per cent. of ash, but the coal would not coke. A test of the coal made on the Central Railway, and recorded in the above report (page 10), showed good results, and that it was a good steam coal with little ash. Regarding the coal in the Winton bore, quoting from official records, Mr. Dunstan stated that its position was 130 miles south-west from Hughenden, about 210 miles south-east from Cloncurry, and 360 miles south-west from Townsville. Several small seams had been reported, but there was nothing to indicate anything larger than a two-feet seam. Several smaller seams than that had been found in the bore. The quality showed 50 per cent. of fixed carbon, 46 per cent. of volatile hydrocarbons, and five per cent. of ash. It did not form a coherent coke. He could not say whether it would make a good smelting coal, as the sample that had been tested had been too long exposed; otherwise, the percentages showed a very fair coal, and possibly a fresher sample would give more satisfactory results. The position of the Mackenzie River coal was 80 miles from St. Lawrence (Broadsound), and 40 miles added to that would give the total distance from the Mackenzie coal deposits to the Marble Island iron ore as 120 miles. A railway could be constructed to the coast over dead-level country, except where it would cross the Broadsound Range, while the length of the line would be less than 100 miles. The coal outcrops on the Mackenzie River, and had been traced for ten miles. If it extended over only that distance—and his opinion was that it was vastly greater in extent—the estimated quantity of coal available would be 200,000,000 tons of coking coal. The width of the seam was given as 20 feet. A prospecting company had a lease of the country, and they were trying to trace the outcrop towards the Central Railway. He had no doubt that it would ultimately be found on the Central Queensland Railway. The quality of the coal was shown in the plan and table exhibited to the Commission, and indicated a very high percentage of coke. The Ipswich and other southern coal did not give 60 per cent. of coke on an average, whereas this ran up to over 80 per cent. in laboratory tests. While the coal in the 20-feet seam yielded 82 per cent. of coke, which contained 11 per cent. of ash, three feet of that seam had only 7.7 per cent. of ash in its coke, and the coal produced 84 per cent. of coke. Speaking generally, the deposit was magnificent in quality, while the quantity was inexhaustible, if coal could be said to be inexhaustible. In a report on these coal measures—"The Geology of the Dawson and Mackenzie River," with maps and plates—written by himself (and which would be handed to the Commission), he had estimated 5,000 square miles of country to be coal-bearing, and there were possibly other outcrops not yet discovered. The particulars with regard to the Dawson River coal were shown pretty clearly in the plan and table referred to, and details were furnished in the Dawson-Mackenzie Report. A remarkable feature of this coal was its uniformly low percentage of ash—4.8 per cent. Particulars regarding the Callide Creek coal deposits were also shown in the plan. It was a non-coking coal, of extra fine quality, and the quantity was estimated by Mr. Rands to be 50,000,000 tons. It had been worked under lease, but he understood negotiations were now in progress for its purchase by an English company.

By Mr. Watkins: The estimate had been made by an officer of the Geological Department, who had visited the field and inspected the shafts. The quantity was easy to estimate, because the seam was so regularly bedded. From its surface the depth of the coal was about 40 feet or 50 feet, and the thickness of the coal passing through the various shafts was about 21 feet.

Mr. Dunstan, continuing his evidence, next referred to wolfram and molybdenite, minerals very valuable in steel manufacture, which he said were now being exported from Thornborough, on the Hodgkinson, in North Queensland. In 1902, eighty men were employed in mining for these minerals, and the value of the output was £6,793. Chromite and manganese were also valuable in steel manufacture. Chrome ore was found in a belt of country extending from Keppel Bay north-westerly to Marlborough. It was in innumerable patches, spread over a large area, but the quantity in each case had not been shown to exceed 100 tons. One gentleman had stated that a deposit exists which was said to be a mountain of chromite and ironstone, but as it was not protected he would not divulge its locality further than that it is in the heavy country to the north of Rockhampton. As to the quality, analyses had been made, and from those available the stone had been shown to contain about 50 per cent. of sesquioxide of chromium, but the average very probably would not be over 30 per cent. Deposits of manganese had been found at Mount Crosby, nine miles from Ipswich, on the Upper Brisbane River. Some of these had been examined, and analyses indicated the mineral to be very rich. There were numerous outcrops in the locality. The deposits were most irregular, but masses of 100 tons and less were known. One deposit analysed showed about 50 per cent., and another (said to contain 100 tons) 70 per cent. of manganese dioxide. Manganese had also been found at Balcomba, 50 miles west of Rockhampton, and 18 miles north of the Duaringa Railway Station on the Central line. The deposit was difficult of access, being in mountainous country. A quantity of 500 tons was actually exposed on the surface in irregular deposits, but easily mined. No analysis had been made, but the ore was estimated to contain 50 per cent. of manganese dioxide.

Asked as to whether the Queensland coal was being largely used, Mr. Dunstan said the deposits of which he had the highest opinion were not being used. The Ipswich and Burrum coal was being used for ordinary steam, but not for metallurgical, purposes. He thought coke could be produced at Ipswich suitable in every respect for the smelting of iron. Queensland imported some coal from Newcastle. Nothing had been attempted in Queensland in the direction of the manufacture of iron. Experiments had been made with the ironstone from Iron Island, and these experiments had been very successful in producing iron that has been worked up in the shop, but only as a specimen. Speaking generally, and looking at the plan and table which he had prepared, Port Alma could be taken as a centre of a circle having a radius of 145 miles, and within that circle could be found all the minerals or materials (except wolfram and molybdenite) necessary for the manufacture of iron and steel, while wolfram and molybdenite were obained at Thornborough, west of Cairns, Northern Queensland. From a geological point of view, there was no reason whatever why the iron manufacturing industry could not be successfully established in Queensland.

By Mr. Groom: No complete survey had yet been made of the iron deposits of this State, but Mr. Ball, an officer of the Queensland Geological Survey, was now, and had been for some months, engaged in examining the iron deposits throughout Queensland. As the work progressed, it was found that the deposits were so numerous, and were spread over such a large area, that the task would occupy a much longer time than was at first anticipated. Those already enumerated were in close proximity to centres of population; but there were vast areas of Queensland still unexplored, and it was hardly possible for these to be examined without fresh deposits being discovered. The Pittsworth deposits had not yet been inspected, but they would ultimately be examined in detail. The estimates which he (Mr. Dunstan) had given were the minimum—very low and cautious estimates, and by no means represented the quantities which might be obtained.

West Moreton Witnesses.

Joseph Hardgreaves, mining surveyor, residing at Ipswich, and representative of the Ipswich and West Moreton Mining Managers' Association, examined by Mr. Groom, stated, with regard to the Ipswich coal beds, that the developed country would be about 120 square miles in extent, while there was, he thought, five times that area undeveloped. So far they were only on the fringe of the coal, and had not gone to any great depth. As to the quality of the coal, there were several seams that were particularly suitable for coking—those on the north side of the Bremer River. Some of this coal had been tested, and had been found to be equal to, if not better than, any in the world. His opinion as to the possibilities of the output was that it was unlimited. There were at present 21 seams being worked separately, but it was possible some of these might be found to be one and the same. This coalfield produced about 360,000 tons last year. Working under present conditions, and without the expenditure of any further capital, three times that quantity could be turned out. He read several certificates from experts and others, including Professor Pepper, as to the high quality of the Ipswich coal. The coal had been used for smelting purposes at Broken Hill. There were several deposits of siliceous clay and limestone in the Ipswich district. One thing in favour of the Ipswich deposits was that they could be worked with small capital. Coke made from Ipswich coal had been found suitable for smelting—none better.

By Mr. Watkins: He thought large quantities of the Ipswich coal were sent to Broken Hill, but the freight told against it. There was no objection to the quality. The reason no more coal was put out was because there was not sufficient demand for it. Coal had been imported from Newcastle into Queensland, but last year the quantity was only six per cent. or seven per cent. of the total consumption. The reason for this importation was because the same freights had been charged to the north from Newcastle as from Brisbane, and because ships going from the south to the northern ports of Queensland for fruit, and having little forward loading, carried New South Wales coal as ballast, and sold it cheap on the ship's account. West Moreton coal had been exported; some had been sent to Valparaiso. The difficulty had been the want of special facilities for quick loading, but these had been much improved of late. On the Queensland railways Queensland coal only was used; they would not take anything else. The price of the best coal was, he thought, from 7s. to 8s. per ton. Ipswich coal could be supplied at the pit's mouth at 6s. 8d. per ton. The reason why it could not compete with Newcastle coal at 11s. was because there was not the same shipping facilities.

By Mr. Kingston: The average earnings of the Ipswich miners, working full time—7 o'clock till 4 o'clock—were £2 10s. a week. Miners were paid from 2s. 10d. to 3s. 9d. for hewing and wheeling, according to the character of the seams worked. The men were now hardly working more than half-time—a great many of them were not earning more than £1 5s. per week. From year to year they averaged quite three-quarter time. It was a time of depression now, and one result was that many men were leaving the district.

William Bendley, who stated that he had a knowledge of the iron ore deposits of the Ipswich district, said there were seven lodes covering an area of about 730 acres. The lodes averaged from three feet to four feet in thickness, but he did not know anything as to what they would assay. He produced a sample of iron ore, and said there were several as good as that. He had had no practical experience in the mining of iron.

Mr. W. Fryar's Evidence.

William Fryar, Inspector of Mines, Southern Division, questioned by Mr. Watkins, said he had held the position of inspector of mines under the Queensland Government for twenty-one years. During the first year of his service he was inspector for the whole of the colony, but after that only for the Southern and Central Divisions, where all the coal mines except one were situated. He was of opinion that the coal produced in Queensland was suitable for the smelting of iron ores. He had seen coke produced from it; and he thought the coke from coal obtained on the north side of the Bremer, at Ipswich, was equal to any that could be produced in the southern hemisphere, while it could be still further greatly improved by washing. He had not actually seen the coke used for smelting, because there had not been any smelting operations carried on here, except at Aldershot. Asked as to the extent of the coal fields of Queensland, he said those of the Central district were said to contain 40,000 square miles. The Southern district had been opened up to the extent of 120 to 150 square miles. He produced a list of thirty-one mines, twenty-five of which were in the Ipswich district, three on the Darling Downs, two in the Wide Bay district, and one at Clermont. Four of these were idle. Practically the same coal measures extended from a short distance west of Ipswich to the Darling Downs. The question whether coal was near enough to the iron ores to allow of the latter being successfully manufactured depended greatly on the cost of carriage. For instance, the distance from Ipswich to the North was considerable; but if the coal measures were in the immediate vicinity of the ore, the position would be much more favourable. Of the iron ores of the Ipswich district with which he had come immediately in contact, he had not formed a favourable opinion, but that was a matter that came more within the sphere of the geologist. He had seen no large beds of ironstone in the immediate neighbourhood of the coal seams of Ipswich. The Styx River coal was in close proximity to the iron ore of Iron Island, and would be near enough to warrant their being worked together. Then there were not only iron and coal, but limestone also, in close proximity, and he certainly thought that in that locality there were all the essentials for the successful establishment of the iron manufacturing industry. One reason why nothing had been done in this direction hitherto might have been because the demand had been too limited. It was only recently that our productions could go into the other States without paying duty, and the State market was not sufficient. An Australian market was a different thing. In the Ipswich coal mines, from 1,000 to 1,300 men were employed—about 1,000 below ground. The output of coal had increased regularly, with some variations, since Separation. The production during the past four years has been: 1899, 494,009 tons; 1900, 497,132 tons; 1901, 539,472 tons; 1902, 501,531 tons. The reason for the falling off last year was the same as had operated in other industries—the general depression; and because steamers, having little freight for the North, had carried coal from Newcastle at low rates. He thought the establishment of ironworks would increase the output of coal. He did not think it would help us much to establish works in the southern States, but he was speaking of the Commonwealth generally. He could not say whether it would be possible to establish ironworks here without assistance from the Crown. He certainly thought to establish such works in the State would be a benefit to the State. Very little coke had been sent from here to Broken Hill. There was no other loading except the coke, and that made the carriage very costly. We had no reason to fear that iron smelting could not be successfully carried on with our coal; on the contrary, the coal was of a superior quality for the purpose, and he thought it could be vastly improved by washing.

Captain G. A. Richard's Evidence.

Captain Geo. A. Richard, Metallurgical Engineer of the Mount Morgan Gold Mining Company, was the next witness examined. Questioned by Mr. Kingston, he stated that he had had about twenty years' practice, and had had considerable experience in metallurgy, including iron and steel. He was in a position to express an opinion as to the prospect of successfully establishing iron and steel works in Australia. In 1901 he visited the United States, and was all through their iron and steel regions. He went with a special object connected with the Mount Morgan Company, but took the opportunity of studying the iron and steel industry from end to end—from the mine, through the transport, to the manufacture of iron at Pittsburg. He also visited the works at Colorado. While in America he also obtained all the statistics he could get relating to wages, the distances over which the raw material was railed and shipped, and especially as to the cost of manufacture. He was therefore in a position, with his knowledge of the resources of Australia, to compare the prospects in Australia with actual experience in the United States, and his opinion was that iron and steel could be successfully manufactured in this country. Since he had come back, knowing that he might be required to give evidence before the Commission, he had carefully looked into the question and gathered further statistics, and he was quite satisfied on the subject. When in London, during his recent trip, he discovered that two propositions were before investors for establishing iron and steel manufactories in Australia, and he had an opportunity of going through the reports of experts on those propositions, with the result that those reports confirmed the opinion which he had already formed. He estimated that the cost of producing a ton of pig iron at Pittsburg varied from 32s. per ton to 38s. or 40s. per ton. That was the cost of production. As to the cost of producing steel, he had not gone into that sufficiently to give a precise estimate, but, roughly, he would put it down at about half the selling price. The price of the pig iron varied, but the statistics which he had with him gave the lowest price in America as £1 15s. 4d., and the highest £3 19s. 2d. The Mount Morgan Company paid for pig iron landed in Keppel Bay in 1901, £5 5s., £4 15s., and £5 5s. per ton for different shipments. As to the relative cost of steel, when pig iron cost a certain sum steel proportionately cost so much more. On an average, when the selling price of pig was £1 11s. 10½d., steel was £3 6s. 9d. That was a good average rule—that steel practically cost twice as much as pig iron. Those prices were at the factory; pig iron was generally bought f.o.b. in America. As to the cost of a ton of pig landed in Australia, he could not give anything closer than the Mount Morgan figures. He was satisfied that pig iron could be produced in Australia at the same price as in America. He spoke from his knowledge of the iron and other mineral resources of this country, and he had compared the conditions of the two countries piece by piece—wages, cost of living, cost of transport, cost of coal and coke, and so on. He was speaking of Australia generally, and that included Queensland generally, although not specifically. In Australia the coal and ore were much nearer the seaboard than in America. As a rule, it was better to take the ore to the coal than the coal to the ore, although sometimes there were conditions—such as return loading—which formed exceptions. The iron and the coal were very rarely close together. There were only two instances in the world where iron and coal were found close together in large quantities—in England and Alabama. The wages throughout the iron regions of America were very similar to those paid in Australia. About 1s. an hour was the average of the iron workers in America. He had not worked out exactly the cost of producing a ton of pig in Australia, but it would probably be from 38s. to 40s.—

practically the same as in America. He was satisfied there was no reason why it could not be produced at about that cost—a little more or less; and there was nothing to lead him to doubt why it could not be placed on the market in Australia at the same price as it cost in America. In forming that conclusion, he considered the cost of materials, &c.—iron ore, coke, limestone, manganese, labour, and sundries. The different costs of producing a ton of iron in Australia should be, approximately—1.8 tons of iron ore at 5s. 6d. per ton, 10s.; half a ton of fluxes, 4s.; labour, 5s.; repairs, 3s.; sundries, 3s. That would be under the most favourable conditions, and he had not allowed anything for interest on the cost of plant or for management, which were allowed on the American estimate. These items, in the case of a large output, would come to a very small sum—possibly 1s. or 2s. per ton would be sufficient.

Asked whether he recognised the necessity for a bonus to assist the establishment of the iron industry, Capt. Richard said he did, and stated that, without such assistance, it was very hard to get people to have anything to do with it. He had made it his business to talk the matter over with men of capital in London, and he found they had got it into their heads that wages were high in Australia, that labour conditions were unsatisfactory, and that these elements made it risky to invest capital here, especially in new enterprises. He believed the offer of a bonus of £250,000 would induce the embarkation of the necessary capital—that it would assure a certain result. He believed the requirements of Australia in the shape of manufactured iron would be about 200,000 to 300,000 tons per annum. Works to produce that quantity would not be a very large works, and would cost something between £750,000 and £1,000,000, although that would depend upon certain conditions—such as whether the works provided their own freight steamers and built branch railways. He also called the attention of the Commission to the way in which the world's demand for iron was increasing, and presented some statistics in proof of his statement.

By Mr. Groom: As to what were Australia's chances from this demand, he thought there was going to be a very big demand in the East, that Australian works would not only be able to supply Australian demands, but compete with the United States for the Eastern trade.

By Mr. Kingston: There was only one works in the Pacific Ocean, at Japan. Australia could compete with America, because her works could be put at the seaboard, while the Americans had to pay 9s. per ton to get their ore to port. Germany had low wages, but low-grade ores and high cost of transport. The United States, too, had heavy royalties to pay. Australian ores were better than the German, and were equal to the American, with carriage in favour of Australian. He was satisfied that economic conditions favoured Australian works as against German or American. When he was in America the people there were searching the Pacific slope for material to supply the Eastern demand, but the result, he believed, was very unfavourable. One reason why a bonus was necessary to overcome the "inertia" of capital as far as Australia was concerned was that large capitalists in America and Europe had their money invested in railways, vessels, &c., and they naturally preferred spending their money where their present undertakings existed. Here we had not that huge capital that existed in other places, and we needed to offer special inducements to overcome the "inertia" of which he had spoken. The demand was increasing so rapidly that new works would have to be erected somewhere. While it was a fact that some works had been closed down, others had taken their places in more favourable positions, and under very much more favourable conditions. This illustrated the necessity of having works established under the best conditions, such as prevailed in Australia. The tendency now was to put the works where the raw material was best and and cheapest. In this respect Australia had everything in its favour, but the difficulty was to get capitalists to realise the advantageous conditions which existed here. He had compared analyses of the Lake Superior iron ores with those of Australian ores, and had not found that the former were better than the Australian. He was aware that large quantities of Spanish ores had been introduced into England. He had seen specimens of coal from the Dawson River. It seemed to be a semi-anthracite, but he had not analysed it. It was not quite as good as the Pennsylvanian coal. During 1901, 7,154,000 tons of iron had been smelted with coke, and 2,500,000 tons with anthracite.

By Mr. Groom: The estimation of the Queensland iron ores, so far, were based on surface indications, and could only be that of hard ores. The greater proportion of iron ores were hard on the surface, but softer lower down. He knew of one case in America where the soft iron had not been discovered for fifteen years.

By Mr. Watkins: The Tasmanian ores were hard ores. For this reason he did not attach much importance to an estimation of ore in sight in flat country.

Mr. Kingston: But you attach importance to it when it is practically in sight to the extent of 1,000,000 tons?

Captain Richard: If only a few hundred tons were in sight there might be a very big mine lower down. The work of discovering mines was quite a separate business in America. In Queensland our iron deposits had not even been trenched on.

By Mr. Groom: Although there were some conditions in Australia not so favourable as in America, there were more conditions in this country that were favourable. The conditions at the Blyth River, Tasmania, were very favourable.

Mr. Watkins: You are very distinctly of opinion that iron can be manufactured in Australia at the same cost as in America. Can you explain how, with a difference of about £3 per ton, in favour of Australia, between the the selling cost in America and the price landed in this country, capitalists still require a bonus to induce them to embark in the enterprise?

Captain Richard: He had already explained that in America there were a great many large capitalists—millionaires—who had already vested interests in their own countries, that iron and steel works would improve the undertakings in which their money had been invested, and that they naturally preferred to do what they could to advance the enterprises in which they were personally interested. Similar conditions prevailed in England and in Germany. He would point out, also, that the iron and coal resources of Australia had only been studied quite lately—in Queensland only for a few weeks; and capitalists liked a thing to mature before investing their money. Moreover, pioneers in an industry, who ran special risks, expected to be rewarded for those risks, and for the advantages which they conferred upon a country by their enterprise. Then recent legislation in Australia had had an unsettling effect.

Mr. Watkins: In what respect?

Captain Richard: The Wages Board in Victoria, and legislation of that sort. Capital was always very timid. There were also the risks of mistakes in management. For instance, works might be placed in a wrong position, and other works, more favourably situated, might be erected and cut them out of the market. Again, works might be ill-designed, and there might be law suits for an infringement of patents. At the present time, big iron and steel works in Japan, costing £3,250,000, were now in financial difficulties, and were compelled to increase their capital by about 30 per cent. That was partly a State and partly a private enterprise. The management was in private hands. He thought the proposed bonus of £250,000, or a tariff duty, would be sufficient to ensure the establishment of works in Australia. Even with the margin as to prices already mentioned, he did not think it would be safe to start without assistance of that kind. From the Queensland coke which he had seen, and his experience of rough tests, it seemed to him to be a very good coke—a very good coke indeed. He had heard it very well spoken of by people who had used it. Mr. Dunn, the manager of the smelting works at Aldershot, where the Burrum coke was used, said it was very good. At Mount Morgan nothing but pig iron was smelted. Queensland coke was used there, and it was found to be very suitable. In one place in Canada—Nova Scotia—wages were about 6d. per hour, the men working twelve hours a day; and that made Canadian iron so cheap. The iron ore deposit in Queensland which he considered the most promising was that at Iron Island.

By Mr. Watkins: If the bonus were granted, he thought more than one works would be established in Australia. Iron would be produced not only for Australian consumption, but for export. He thought there was room for more than one works, and that the results would be that, owing to competition between the local manufacturer and the importer, prices would be reduced to the consumer.

By Mr. Groom: The price which he had given as the cost of a ton of ore (5s.) was a special case, and he thought it was low. He would put another 5s. on to that. In that estimate no charge was made for royalty.

By Mr. Kingston: He had no personal interest in the iron industry.

MR. BALL'S EVIDENCE.

Lionel C. Ball, B.E., Assistant Government Geologist, Queensland, in answer to questions put by Mr. Kingston, said he was the author of the report on the "Iron Ore Deposits in the Gladstone District," which had already been laid before the Commission. As to the prospect of successfully establishing the iron industry in Queensland, he was not prepared to offer an opinion as far as the commercial aspect of the question was concerned, but could speak from a geological point of view—as to the resources necessary for such an enterprise. He had not seen all the deposits of iron ore in Queensland, but he had examined some, and had thoroughly inquired into the question generally, with the result that he was quite satisfied that Queensland had all the necessary resources for the successful establishment of the industry, including fuel and fluxes. He was in a position to say that there were large deposits of iron ore of good quality in this State suitable for the manufacture of iron, and he could say the same with regard to coal, limestone, and everything that was necessary for iron and steel manufacture. Speaking of the chief iron ore deposits, and without going over the same ground as Mr. Dunstan, he first referred to Kangaroo Hills. He had not seen the deposit at that place himself, but had information from a report by Dr. Jack in 1898. (G.S.Q.P., 82, "Kangaroo Hills Silver and Tin Mines.") Dr. Jack said:—"The 'Iron Mountain' . . . culminates in a considerable hill. . . . It is undoubtedly a lode of vast proportions, and is traceable for certainty to at least forty-five chains. . . . The lode matter affects the needle so powerfully that the compass is practically useless in its vicinity. . . . The lode . . . is, where first seen, at least 33 feet wide, and its cap consists of manganiferous iron glance. Lillie's Shaft has been sunk on it at 'Powell's Knob' to the depth of 101 feet. . . . North-eastwards of Lillie's Shaft, the lode gradually increases in dimensions, till at the 'Iron Mountain' it is about two chains wide. The crag already mentioned consists of garnet rock, iron oxide, and iron oxide mixed with manganese oxide." The deposit is 30 miles from the sea at the nearest port (Halifax Bay), and 60 miles from Townsville. There is at present no township at Halifax Bay, and Townsville would probably be the port, although it was possible that it might be made Halifax Bay. Dr. Jack, in the map attached to his report, shows that there is more limestone than iron in the district, and it was known that this limestone was suitable for fluxing purposes. Iron Island was one of the smallest of the Duke Group of islands, and was 40 miles north-east of St. Lawrence. It was also close to Marble Island, connected with it at low tide, while there was deep water close in shore on the south side. Iron Island was 20 chains in length and 10 chains at the greatest width; and the whole of it, except five chains at its northern end, and a strip one to two chains wide on the west, was iron ore. He had calculated that the quantity above the water level was 2,500,000 tons. He believed the deposit would be persistent in depth. He had an analysis of a sample of the ore, as follows:—

	Per cent.		Per cent.
Water	0·13	Lime	2·85
Silica	2·51	Magnesia	1·07
Alumina	2·95	Phosphorous	0·065
Iron	64·72	Titanic Acid	Nil.
Manganese	Nil.		

This sample was made from a specimen taken over the whole of the island. An analysis of a single specimen gave:—

	Per cent.		Per cent.
Water	0·46	Lime	5·53
Silica	1·73	Magnesia	Trace
Alumina	2·71	Phosphorous	Trace
Iron	63·94	Titanic Acid	Nil.
Manganese	Nil.		

The amount of phosphorous in the first sample was rather high for the acid process, but this would probably be eliminated by taking samples from different portions of the island. A percentage of 0.05 of phosphorous would be rather high, but some of the Lake Superior ores showed 0.06 per cent., this being reduced by sorting. Iron Island was now held under mineral lease, and he understood it has been taken up during the past few weeks. It was not at present being worked. In the vicinity of Stannage Point, on the mainland, about 30 miles from Iron Island, there was also a deposit of iron ore. It was a small deposit. About 7,000 tons was in sight, of very pure ore, with no phosphorous. It contained about 60 per cent. of iron. There were iron ore deposits in the vicinity of Mount Morgan, totalling about 250,000 tons. The quality was good, showing 55.80 per cent. to 62 per cent. of iron; silica, four per cent. in one sample and 2.5 per cent. in another; phosphorous, a trace in one case and 0.080 per cent. in the other. The latter would be unsuitable for the acid process. A deposit at Mount Biggenden was shown in the plan and table tendered by Mr. Dunstan. (G.S.Q.P., No. 173, "Mount Biggenden Gold and Bismuth Mine"). This was now being worked for bismuth, and the iron magnetically separated was shown to be pure. There were 82,000 tons in sight there. At Olsen's Caves, 14 miles north-north-west from Rockhampton, there were several outcrops of iron ore, and analyses of these showed 67 per cent. and 73 per cent. of iron, with a trace of phosphorous in one case and none in the other. That made it almost absolutely pure ore. At Alma Creek, shown on the plan and table, there were deposits of titaniferous ore. He read two analyses of the ore:—

	No. 1.	No. 2.
	Per cent.	Per cent.
Water	0·54	0·56
Silver	5·55	10·40
Alumina	12·52	1·70
Iron	55·10	56·27
Manganese	Nil.	Nil.
Lime	2·65	2·85
Magnesia	Nil.	Not determined.
Phosphorous	Trace.	0·025
Titanic Acid	Present but not estimated.	Present but not determined.

The second analysis was from a separate deposit. In the Brisbane and Ipswich districts there were also deposits of iron ore, which were shown on the plan and table. Nothing had been done in the way of working them. In the Gladstone district the most important deposit was at Glassford Creek, and this was also shown on the plan. None of the Queensland iron deposits had been worked except for fluxes for the smelting works at Aldershot. The iron ore deposit which he considered the most valuable or the most capable of successful future working was that at Iron Island—that was the one to which he attached the most importance for the purpose of manufacturing iron. Next in order he would take Mount Lucy, on the Chillagoe Railway. In connection with the iron on Iron Island, there was an island close by giving an unlimited supply of limestone. Speaking generally, in all cases where iron had been found in the State, there was abundance of limestone close by except in the Ipswich district. As far as was at present known, the most important deposit of limestone was that at Mortar Island. The deposits at Mount Etna, near Rockhampton, were being worked. He had made some notes regarding the Burrum coal, and had a report by Mr. Rands, a former Government Geologist, and himself. (G.S.Q.P., No. 170, "The Burrum Coal Field.") Howard, the centre of the coal field, was 18 miles north-west of Maryborough by rail. The average percentage of coke shown in the Burrum coal was 66.8 per cent. This was a field likely to be largely drawn upon in the future. It had been worked for the past twenty years, and there was certainly as much coal likely to be taken out in the future as had been got out in the past. The best analysis that had been made for coking purposes showed only three per cent. of ash. As to which was the best coal for smelting purposes, there was a doubt as between the Ipswich and Burrum coal, but at present metallurgists preferred the Burrum. Chromite occurred at Ipswich, but it had not been worked, and and the quantity was not known. At Mount Miller, six miles from Gladstone, there was manganese ore. Manganese was absolutely necessary in the making of steel. The quantity at Mount Miller had been estimated at 160,000 tons. The quality of the ore was better than that ordinarily used for smelting purposes. It was not at present being exported for this purpose, but it was proposed to do so. There was a small amount of manganese near Ipswich, but it had not been examined. He was quite satisfied that Queensland had all the requisites for the satisfactory establishment and maintenance of the iron industry within its borders.

By Mr. Watkins: He was speaking purely from a geological standpoint. Seeing that we had a very pure ore, he did not see, if an attempt to establish the industry failed, that it could be the fault of the ore, provided the fluxes were right. He had heard that after furnaces had been erected and used,

EASTERN COAST

uantities	Qualities	Remarks
imated	Not estimated	Both being mined and exported at the present time, output for 1902 valued at £6793
ous lodes of Ironstone ustible supply	: :	———
austible supply	98 % Carb. of Lime	———
.000 tons .000 tons	Iron Silica Phosphorus 64·7 2·5 0.065 60 ? nil.	A specimen block assayed a trace of Phosphorus
nis aggregating of Coal	(Max.) 11% of Ash in Coal (Min.) 3·8% of Ash in Coal	Good Steaming Coal, makes firm Coke
timated	Not estimated	Numerous irregular Outcrops
eam. Outcrop proved es in length	(Max.) Ash in Coke 11% (Min) Ash in Coke 7·7%	Coal yields 84% Coke (Max) 82% Coke (Min)
ps 1 mile long 9ft 6 in. thick	Fixed Carbon in Coal 84·6% Ash in Coal 4·8%	Frits when burning, but Coke is not formed
00 tons austible supply	Iron Silica Phosphorus 67 to 73 ? none to trace	———
austible supply		200 yards from water's edge
00 tons	Iron Silica Phosphorus 55 to 62 2·3 to 8·3 trace to 0·167	
00 tons	55 to 56 5·5 to 10·4 trace to ·025	Many other Ironstone Outcrops in this District not examined
000 tons	No analysis	Magnetic separation possible
C00 tons	Manganese 44% Silica 11·5% Iron 4% Phosphorus trace	Many Deposits not included
l Deposits	No analysis	Many Ironstone Deposits containg from a few hundreds to a few thousand tons each
0.000 tons	11% of Ash in Coal.	Contains 9% of moisture a good Steam Coal
0 tons. austible supply	No analysis	Magnetic separation possible.
s have been worked ating 16 ft of Coal	2% to 7% Ash in Coal	Coke is used at Aldershot and Mt Perry furnaces
crops known	No analysis	Aggregate thickness probably 20 ft associated with Coal Seams
small quantities	Probably too Siliceous	Deposits at Pine Mountain
us Outcrops each s or less	50 to 70% Manganese Dioxide	Deposits very irregular
imated	No analysis	Boulders on surface at Pine Mt quality apparently good
e annual output 0.000 tons	Coke-hard. 15% Ash from unwashed Coal	Washing would reduce ash in Coke probably to 8%
timated	Not estimated	

even with suitable ores, it had been necessary to pull them down and reconstruct them, but he could not speak of any particular cases. He had not examined our coal with the view of ascertaining whether it was specially suitable as a smelting coal. He believed the coal could produce coke good enough for the purpose, but that was a matter for actual test. He certainly believed that the output of coal would increase, not diminish.

By Mr. Groom: It was only during the sittings of this Commission that he had been specially examining the iron deposits of the State. Before that he had commenced a report on the manganese and iron deposits, but since then he had been solely directing his attention to iron—only during the past month or so. As to the clay ironstone deposits of the Ipswich district, there were ten outcrops within two miles. One seam was two feet six inches thick. Such a seam would contain 11,000 tons of ore per acre. There was no reason why these deposits should not occur throughout the Ipswich coal measures. Even at that thickness they might be worked, but they would not be considered important deposits. The Pine Mountain deposits on the surface were too siliceous, but they might improve with depth.

This closed the evidence taken in Brisbane.

V.—NOTES ON ASBESTOS IN THE ROCKHAMPTON DISTRICT.

For many years asbestos has been known to occur in the serpentine belt which extends in a north-westerly direction from Balnagowan, near Keppel Bay, to Yaamba, Princhester, and Marlborough.

Near Princhester there are some old workings which were opened many years ago to determine the character of the asbestos deposits there. Recently Mr. E. K. Ogg, of Rockhampton, visited the locality, and from the old workings obtained samples of the asbestos for the purpose of making an examination, and to determine their value as a commercial commodity.

The country is serpentine, and the veins of asbestos occur in all sizes up to a foot or more in thickness. The asbestos in the larger veins is coarse in texture, but one sample from a seam about two inches in thickness showed asbestos of a much finer quality. All the samples were much ironstained, and partly decomposed by the action of surface water, the workings not being deep enough to obtain the asbestos unaltered.

Messrs. Hall and Stokes, in a paper read before the Royal Society of Queensland some years ago,* described the asbestos deposits occurring near the junction of Tilpal, Princhester, and Glen Prairie runs, and in their summary regarding the occurrence of asbestos and the propects of establishing an industry in this mineral, states their belief "that, on proper search being made, veins of asbestos of good quality and payable size will be discovered, and that a permanent industry will be the result." They also think that "a wider knowledge of the modes of occurrence and methods of working may lead to search being made in other serpentine areas."

Asbestos, to be valuable, must be pure, clean, strong, fine, and capable of being woven, the latter quality being quite distinct from its degree of fineness, and depending on the somewhat flossy nature of the individual fibres. Many other inferior grades of asbestos are used, however, for manufacturing purposes; but to work asbestos successfully, it appears that the occurrence of the high-class material is indispensible at the outset.

The material obtained recently by Mr. E. K. Ogg, when microscopically examined, shows the fibres to be finer than the best quality of Italian asbestos, but no further comparison could be made, as the sample was too much decomposed; neither, for the same reason, could the structure of the individual fibres be examined to determine their fitness for weaving purposes.

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* Proceedings of the Royal Society of Queensland, 1890 to 1893. Vols. VII., VIII., and IX., p. 120.

VI.—NOTES ON THE GEOLOGICAL HISTORY OF KEPPEL BAY.

The occurrence of the phosphate-bearing slate belt referred to in a previous article, and its association with a serpentine belt, discloses some features regarding the geological history of Keppel Bay.

From Balnagowan, on the mainland, to the west of Keppel Bay, a belt of serpentine rock extends north-westerly towards Cawarral and Marlborough, and are parallel with the slate belt trending in the same direction, while on the other side of the serpentine, at Yaamba, there are masses of Devonian limestone which form, with the slates associated with them, a third belt in the same geological series.

The same series appear to have been repeated in the direction of Gladstone to the south-east. The slates of Curtis Island are similar to those north of Balnagowan and at Cawarral, and there are limestones corresponding to those at Yaamba, on the mainland at Raglan opposite Curtis Island, but the serpentine between the limestones of Yaamba and the Cawarral slates are represented between Curtis Island and the mainland by the depression forming the channel and the low country of the "Narrows."

Curtis Island and the mainland to the north of the Fitzroy River once were connected, and the land now forming Curtis Island was a peninsula. At that time Keppel Bay was not in existence, and the river must have had some other outlet to the sea.

The river at that time draining the country fairly agrees with the course of the Fitzroy River of the present day so far as the upper reaches are concerned, but with the slate country of Curtis Island joined up with Cawarral, and Keppel Bay non-existent, the river has trended away to the south-east, and following the line of rocks which least resists its denuding action, has made a course for itself in the serpentine belt, and flowed along the west of what now is Curtis Island in the present channel of the "Narrows."

The country to the west of the peninsula must have been low and swampy, and a vast quantity of sand and mud brought down the river has accumulated there to form a series of sandstones and shales. While this filling-up process was going on the river gradually wore away part of the peninsula, through which a second outlet to the sea was made, thus forming Curtis Island, and with the opening of the new channel the old one by degrees became closed.

Since then the country has been subjected to some alterations in level, and the Mesozoic rocks have been slightly raised and brought with the influence of surface-weathering agencies. The slight elevation produced great changes in the configuration of the country here by converting the low, swampy country into an elevated plain, but the subsequent wearing-down action of both the river and the sea reduced this so much that very little now remains to show it ever existed. Mackenzie Island is a very small remnant of this sandy plain, and other small portions of it are to be found about the "Narrows."

Looking backward in the history of these events, we see one period—probably in early Tertiary times—when Keppel Bay and all its islands was an area of dry land connecting up Curtis Island with the mainland at Cawarral and forming a peninsula. Mackenzie Island was then part of a sandy plain, and extended round all points of the compass; extended easterly towards the peninsula, northerly towards Balnagowan, westerly along the north and south banks of the Fitzroy River, and southerly to Port Alma and the country about the "Narrows."

The Fitzroy River, flowing easterly, formed a channel through the plain of Mackenzie Island sandstones, and when it reached the slates of Curtis Peninsula trended south-easterly along the course of the Narrows to enter the sea at Port Curtis.

VII.—ORIENTAL RUBIES IN THE TATE RIVER, NEAR CHILLAGOE.

◆

While travelling across from Cairns to Croydon, inquiries were made in passing through the tin districts concerning the occurrence of rubies with stream tin. A number of red stones in the possession of the miners were examined, and although the locality they came from was not visited, some of them were found to be Oriental rubies. Zircons are plentiful in the tin "wash," and garnets of exactly the same colour as the rubies have been found with the latter stones at the "Rocky" Tate River. Two rubies of commercial value were obtained from one of the mines—one being about a carat in weight, the other a carat and a-half, both of a bright clear colour. The garnets matched the rubies perfectly in colour when cut, although readily distinguished in the rough state by an absence of pleochroism and by their inferior hardness.

It is impossible to surmise what stones of value are thrown away by the alluvial tin-miner, but as the rubies obtained by me were only saved with other stones which the miners consider curiosities, such as zircons and garnets, probably good stones, regarded as valueless, are washed away in the tailings.

It would be advisable for miners to always save bright-coloured, transparent stones, and obtain some estimate of their value from the Geological Survey Office, from which also any other desired information on the subject can be given.

VIII.—ON THE OCCURRENCE OF THE GENUS HALYSITES IN THE PALÆOZOIC ROCKS OF QUEENSLAND, AND ITS GEOLOGICAL SIGNIFICANCE.

By R. ETHERIDGE Junr., Curator of Australian Museum, Sydney.

In the "Annual Progress Report of the Geological Survey [of Queensland] for the year 1900,"* Mr. B. Dunstan announced the discovery of the Silurian genus of corals known as *Halysites*—more popularly called the "Chain Coral" —in the limestones south-west of Mungana, in the Chillagoe District. This is an exceedingly interesting discovery in Queensland Palæontology, and one of high geological importance.

The limestones were at one time regarded as Permo-Carboniferous in age;† subsequently Dr. R. L. Jack‡ referred them to the Devonian, and, lastly, Mr. S. B. J. Skertchly§ again returned to a Carboniferous age, placing the limestones towards the close of that epoch.

The specimens submitted to me are preserved in a blue-black, or almost black limestone, and from their siliceous composition the corals weather out on the surfaces. The colonies are of limited extent, and of an erect and shrub-like growth apparently. The fenestrules are not individually of large extent, the larger measuring 4 x 4 mm. to 4 x 6 mm., and in outline vary from rectangular to oblong, and without such a marked tendency to that polygonal form seen in several of the New South Wales species of the genus; neither does one diameter greatly exceed the other. It follows that the angles of junction of the vertical laminæ, or corallite chains, are not so variable, and often approximate more to a right angle. The fenestrule walls are strong, but, in consequence of the extensive secondary alteration the tissues have undergone, the epitheca is very indistinctly and feebly preserved.

The actual length of the corallites is unknown, but so far as can be ascertained from the mode of preservation, they did not attain any great degree of height. The corallites are all "normal," *i.e.*, autopores only appear to be present; these have a diameter, in the direction of the chain, of from one millimetre to one and a quarter millimetres. The corallite chains are short, only slightly farcimentiform, the number of autopores in a given chain being only from two to four, but the average three. The autopores abut closely against one another, the inter-autoporal walls being thickened, and leaving no space for interstitial tubes or mesopores, of which not a single trace has been observed in any of the sections prepared.

The structure of these thickened walls, whether inter-autoporal or fenestrule-bounding are, when viewed in microscopic sections, perfectly homogeneous.

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* Dunstan—Geol. Survey Report, No. 159, 1901, p. 21.

† Jack and Etheridge—Geol. Pal. Queensland, &c., 1892, pp. 609 and 739.

‡ *Fide* Dunstan, *loc. cit.*

§ Skertchly—Proc. R. Soc. Queensland, 1899, xiv., p. xxiii.

The corallites termed gonopores by me, placed at the angles of junction of the corallite chains, are generally developed, but not invariably so; when absent the autopores at the angles abut closely against one another; when developed they are either round or obscurely polygonal.

The tabulæ are complete, more or less horizontal, and never vesicular; but, owing to an occasional slight obliquity, cut edges are now and then seen in transverse sections of the autopores. The first point that strikes one on examining a longitudinal section is the extreme regularity and delicacy of the tabulæ, presenting precisely the appearance of the rungs in a ladder. Some are one millimetre apart, others three-quarters of a millimetre, and they are either opposite in contiguous corallites or slightly alternating. The visceral chambers are either square or transversely oblong.

The absence of mesopores is also more forcibly brought home to the observer on examining a longitudinal section, for wherever the latter traverses the vertical plane of a corallite chain, the normal tubes are all seen in close contact with one another.

Septal spines are present, but feebly developed, and are arranged in one or two, and possibly three cycles in each visceral chamber.

If the absence of mesopores is truly a structural and not a superinduced character, one brought about by secondary changes in the coral's tissues, the Chillagoe *Halysites* is quite distinct from any of the forms discovered of late in New South Wales. True it is that mesopores in more than one of the latter are unstable in their development, but in none of them are these corallites totally wanting. There is also a marked absence of mesopores in a *Halysites* I described* from the Gordon River Limestone, in Tasmania, and with this a general similarity of other characters, so much so, indeed, that I shall not be surprised to find the two corals are identical.

For the Chillagoe *Halysites* I propose a specific name in allusion to the locality, with the following abbreviated characters:—

HALYSITES CHILLAGOENSIS, *sp. nov.*

Sp. Char.—Corallum forming shrub-like colonies of small size. Fenestrules oblong or irregularly quadrangular, the diameters more or less equal, and the angles approximating to right angles; sizes 4 x 4 mm., 4 x 6 mm., &c.; walls strong, but much altered by secondary silicification; margins straight, or very slightly undulate. Corallite chains short, only in a slight degree farcimentiform; autopores oval, two to four in a chain, about one to one and a-quarter millimetres in longest diameter; septa feebly developed in from one to three cycles; pseudo-columella not observed; tabulæ very regular, complete, horizontal, from three-quarters of to one millimetre apart, opposite or subopposite in contiguous tubes; visceral chambers square to transversely-oblong. Mesopores absent, the inter-autoporal walls solid, and trenchant at the surface. Gonopores generally but not invariably developed, when present round, or obscurely polygonal; tabulæ about half a millimetre apart; visceral chambers square.

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* Etheridge—Proc. R. Soc. Tas. for 1898-99 (1900), p. 81.

Halysites chillagoensis is a form of high morphological importance, for it proves what has been elsewhere foreshadowed (in the New South Wales species), that gemmation may go on direct from autopore to autopore, without the intervention of a mesopore.

The presence of *Halysites* in the Chillagoe Limestones, lends colour to a belief in the existence of Silurian rocks in Northern Queensland. We already know of the presence in the south-west portion of the State, along the South Australian border, about 23° S. Lat., of rocks supposed to represent some part of the Ordovician Series,† and it is not, therefore, unreasonable to anticipate that throughout the great expanse of "slates, schists, greywackes, quartzites, &c., of undetermined age," shown on the Geological Map of 1892, over Central Queensland, and extending even into Cape York Peninsula, some areas at least may prove to be of Silurian age.

I believe I am correct in stating that *Halysites* is unknown in rocks of Devonian age. If this be so, we are face to face with one of two conclusions—either the Chillagoe Limestones containing this coral are of Silurian age, or, the beds in question must be regarded as Devonian, accompanied by an extended range in time for the coral. I favour the former conclusion.

Halysites extends throughout the Ordovician Series into the Upper Silurian, as high as the Lower Ludlow, but a sufficiently extended examination of the Chillagoe corals has not yet been made to warrant the expression of a decisive opinion of their age in particular.

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† Jack—Proc. R. Soc. Queensland, 1895-96, xi., p. 73; and Note on the Discovery of Organic Remains in the Cairns Range, Western Queensland.—*Ibid.*, 1897, xii., p. 47.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY OF QUEENSLAND.
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REPORT.

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IN THE

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SOME MANGANESE DEPOSITS IN THE GINGIN, DEGILBO, AND WARWICK DISTRICTS.

This work was carried out as part of the general scheme of having all the deposits of manganese ore in Queensland inspected and reported on as time permitted. Some of the deposits are acknowledged to be poor, but it is hoped that at some time in the future they may be worked, in order to supply Australian iron furnaces with the necessary manganese ore. The only local demand of any extent at present is that of Mount Morgan, where about a thousand tons a year are consumed in the chlorination process. The management now stipulates that no ore containing less than 70 per cent. available dioxide will be accepted—probably because a sufficient quantity of ore of that grade can be obtained from Mount Miller, near Gladstone. The price paid during 1902 was 1s. 1.3d. per unit, on a basis of 70 per cent., with 1s. 6d. per unit in excess. Ore carrying 70 per cent. available manganese dioxide would thus bring £3 17s. 6d., delivered at Rockhampton.

The London quotations for manganese just now (6th November) are:—

Ore containing 50 per cent. and upwards of manganese,		9d. to 9½d.
„	47 to 50 „ „ „	8d. „ 9d.
„	40 to 47 „ „ „	6d. „ 8d.

i.e., ore containing 44 per cent. of manganese would bring only £1 5s. 8d. per ton. It is evident that only large deposits, most favourably situated, could be made to pay at that price.

GINGIN.

The proved manganiferous country, comprised in an area of 2 square miles, lies 5 miles south-south-west of Gingin Railway Station—the deposits occurring in freehold portions 856, 1033, 917, and 1147, Walla; and Gingin, the centre of a prosperous cane-growing district, is on the Mount Perry Railway, 29 miles from the port of Bundaberg.

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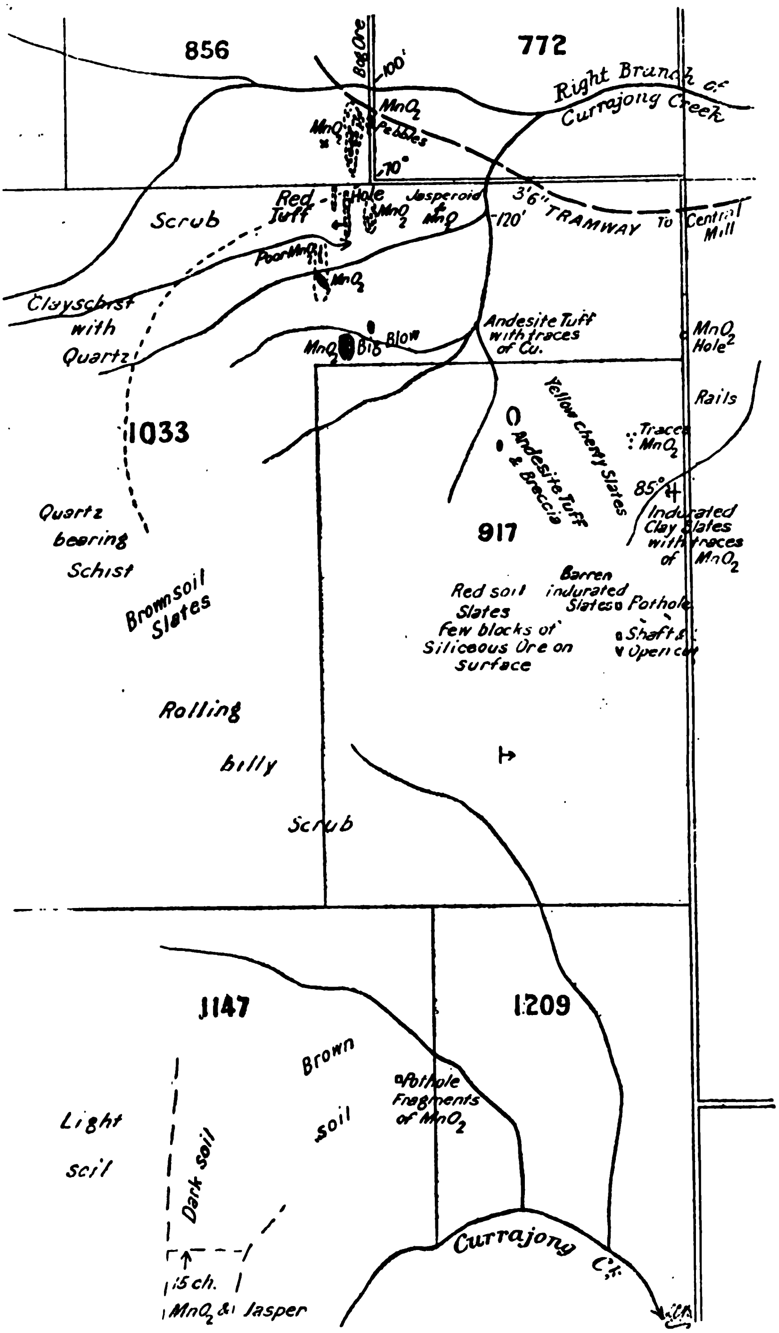

SKETCH PLAN OF MANGANESE DEPOSITS IN THE GINGIN DISTRICT.

Scale: 20 chains to an inch.

Good, fairly level roads run to Gingin, and the Central Mill Private Railway connects with Wattawa Railway Siding. Arrangements could probably be made with the proprietors of the private railway for the ore to be carried to the siding, and heavy cartage freights might thus be obviated.

The manganiferous country is gently rolling. It was formerly covered with dense scrub, but most of it is now under cultivation, the slates forming a rich brown soil. It is drained by Currajong Creek and its Right Branch, and a feature of the country is the number of springs, some of which persisted even in the drought.

General Geology.

A narrow north-and-south-stretching zone of slates and tuffs of undetermined age includes all the manganese lodes. In one or two places indistinct and indeterminable fossil remains were found in the tuffs near the lodes. The beds strike north and south, and dip at high angles both east and west, owing to folding, consequent on compression from east and west.

Clay schists with segregated lenticules of quartz occur west of the slates, and similar country—probably a continuation of the same belt—exists in the Perry Scrubs to the south (already described in No. 184 of the G.S.Q. publications, and in *Government Mining Journal* for August, 1903, p. 400). The soil produced is comparatively poor, and the quartz blows carry little or no gold.

Immediately east and north-east of the manganiferous area the slates are capped by rich red and black residual basaltic soils, but they have been denuded a short distance to the east and north-east, leaving sandstones and conglomerates (of Trias-Jura age) exposed.

The tuffs and slates are apparently of much younger age than the schists, but are themselves much older than the sandstones and conglomerates. Nothing is known as to the age of the basalt beyond that it is younger than the sandstone; but, as none of these rocks appear to have any connection with the manganese deposits, their age does not really concern the present inquiry.

Portion 856, *Walla.*

The area of manganese ore on this portion is in the extreme south-eastern corner, and extends along the eastern side for 10 chains from the southern end. It consists of scattered pebbles and boulders over a width of from 40 yards at the northern end to 2 yards at the southern. At 6 chains from the southern boundary is a solid outcrop 6 feet wide. The wider parts are due to the occurrence of a number of separate lenses, not to a thickening of one single lens.

The northern portion (with the exception of the western part) is formed of a mixture of hard and soft cellular, slightly ferruginous ore of good quality, but towards the southern boundary the fragments of ore on the surface are often found, when broken, to have a centre of rhodonite (manganese silicate), or else of partly replaced slate.

A general sample, taken from the whole outcrop, assays (Government Analyst):—

Manganese	42.4 per cent.
Silica and insoluble	16.3 „

The amount of manganese dioxide was not estimated, but, even assuming the whole of the metal to be peroxidised, it could only amount to 67 per cent., which is rather too low for chemical purposes (Mount Morgan).

The northern end of this deposit is very well worth prospecting, for the discovery of a large lode here would be of great value because of the accessibility of the locality.

Clay slate is the country on the eastern side of the lode, while on the west, together with strongly cleaved clay slates, are highly altered ferruginous andesite tuffs, with casts of indistinguishable fossils and lenticular patches of milk-white calcite.

The road to the east of the northern end of the above deposit, and just south of the Central Mill Tramline Crossing, is covered for a distance of 3 chains with small pebbles of very good ore, possibly derived from a small vein or veins running along the road.

Portion 1033, *Walla.*

Six several areas on this portion have received attention, all lying on the continuation of the zone embracing those in portion 856 and the road adjacent.

Some work has been done 10 chains south-west of the south-eastern corner of 856, a pothole 10 feet deep proving a width of 7 feet of clay-stained manganese ore, seemingly bulging to the south in depth. On the western or hanging wall is a 2-feet band of partly replaced slate, but much of the remainder of the ore is fine-looking blue dioxide, containing, however, much sandy clay, and therefore needing hand-picking and washing. The quality of the ore varies greatly within a space of a few inches, but I believe it will improve with depth. The hanging-wall is fairly well defined and vertical, but the footwall is stained and veined with ore. The country on the west is fissile decomposed purplish tuff slate, dipping 70 to 80 degrees to the west-south-west; while that on the east is decomposed massive slate.

The deposit was found by trenching, and, judging from the fragments on the surface scattered over a width of a chain, it may be 3 or even 4 chains long. A sample from it assays (Government Analyst):—

Manganese	40.5 per cent.
Silica and insoluble ...	20.1 „

This is equivalent to, at the most, 64 per cent. of manganese dioxide.

A second smaller outcrop—probably a separate deposit—is to be seen half a chain up the hill to the west, and partly replaced slate half a chain beyond it.

The next is a couple of chains to the east, on the line of that on the road (referred to under portion 856). Fragments of good ore are scattered over the ground for a distance of 2 chains, and a general sample from them assays (Government Analyst):—

Manganese ... ... 47.3 per cent.,

which is equivalent to, at the most, 75 per cent. of dioxide, but all of this is not likely to be available.

The next manganiferous belt is 5 chains west of the pothole, and has a width and a length (south-east) of a chain. Large blocks of rather soft, sometimes quartz-veined, ore, with central pinkish manganese-stained slate (partly replaced) occur half-way between portions 856 and 917, the manganese apparently lying across the belt. The silica will probably decrease with depth. Tuff slate occurs south of the blow.

Some chains south of the last, and within 4 chains of the north-west corner of portion 917, is a large outcrop known as the Big Blow, on the line of the outcrops in portion 856 and that on which the pothole has been opened. Fragments and boulders up to 6 feet in diameter cover an area 2 chains long (north-west and south-east), and a chain across. There are two manganiferous portions separated by about 4 feet of red slaty tuff containing bunches of manganese ore, the south-western about 5 feet wide, the other 3 to 6 feet wide. The dip is about 60 degrees to the south-west, and gradually gets greater with depth. A third outcrop 20 feet to the north-east is 4 feet in greatest width, and consists of somewhat better ore than the others, but, like them, it also passes into jasperoid at the northern end.

A pothole has been opened to 10 feet depth on the two south-western blows, which are shown to be 6 feet thick, and, though very hard on the surface, to soften in depth. The hanging-wall side of the south-western lode contained carbonate of copper stains—the metal having probably been derived from the decomposition of the andesite tuff.

The ore is certainly not good, being slaty and containing white cherty centres. The outcrop may be only a siliceous cap comparable to jasperoid. In fact, the hanging (south-western) wall is red jasperoid, and the country beyond it is yellow indurated clay slate. The country on the footwall is also sometimes jasperised. The country must have been originally very fine bedded (laminated), and is now contorted. A general surface sample assays (Government Analyst):—

Manganese	33.0	per cent.
Silica and insoluble ...	30.2	„
Iron	2.3	„

The available manganese dioxide can therefore not be greater than 52 per cent. in the sample, although specimens have yielded as much as 62.4 per cent. The ore is too siliceous for chemical work, but the silica may decrease below the surface.

An outcrop of similar ore to the above occurs in a gully 3 chains to the east-north-east of the Big Blow, and fragments have been picked up for some distance in the cultivated ground to the north.

Portion 917.

An area of boulders and pebbles of poor ore, 20 feet across and a chain in length (south-south-east), lies 5 chains from the northern boundary about midway between the sides of the portion. The country rock is andesite tuff and breccia. The deposit probably consists of up to 6 feet of partly replaced rock. The ore is very poor; indeed, almost every fragment having a central part of country rock, it is little more than highly stained and partly replaced country rock. Other small outcrops occur a few chains to the south-west and south-east.

The country on the eastern side of the portion is clay slate, dipping at a high angle to the west, and containing traces of manganese at numerous points.

About 25 chains from the northern and 6 chains from the eastern boundary a pothole has been opened on manganese stained and partly replaced clay slates. Tuff slates also occur here. The ore obtained was of no value for any purpose.

Other trenches were opened on stained country a couple of chains to the south, a chain beyond which are a 21-feet shaft and an open cut. The open cut, 30 feet long and 15 feet in greatest depth, was on a bunch of ore dipping south-east. The footwall is mottled, white and yellow sandy slate, the hanging-wall pink pipeclay. The ore passed at a shallow depth into a thin seam of manganese-stained clay. The few tons of ore obtained was of a good quality, a sample of that left on the surface assaying (Government Analyst):—

Manganese	48.4 per cent.

equivalent, at the most, to 76.5 per cent. of manganese dioxide.

On the one-chain road running north from the north-eastern corner of portion 917 good manganese has been found within 2 chains of that portion. The ore occurred in two over-lapping, north-and-south-striking bunches, 6 and 10 feet respectively in length, making very little outcrop. The ore in the longer northern lens has passed, at 4 feet depth, into manganese-stained material. Some of the ore assayed privately 65 per cent. available manganese dioxide. About 10 tons were obtained, and a sample of that left yields (Government Analyst):—

Manganese	47.2	per cent.
Available manganese dioxide	67.7	„
Silica and insoluble ...	8.2	„
Phosphorus	0.075	„
Sulphur ... trace, less than	0.1	„
Iron	0.91	„

This is rather too low in available dioxide to be accepted at Mount Morgan, but the silica, phosphorus, and sulphur are all within reasonable limits. The country is yellow clay slate striking north and south.

Portion 1147.

A few blocks of manganese dioxide have been found on the north-eastern corner of this portion in brown soil, clay slate country. One specimen from the best block assayed 74 per cent. manganese dioxide, but the greater part of the ore is very poor, and, besides, most of the blocks have slaty silicate centres. Fragments of impure ore can be traced for a quarter of a mile to the south. At one place, 10 chains from Currajong Creek on the east, and 15 chains from it on the south, a pothole has been opened on jasperoid, with a certain amount of ore dipping 45 degrees to the west. Manganese-stained blocks cover an area half a chain in diameter, the amount of manganese may be expected to increase at depth, while the silica will decrease, so that the deposit is worth testing.

Manganese ore has thus been shown to be abundant in this locality, but so far most of it is of rather too poor a quality for it to be payably worked. Manganese ore, however, very often proves far less siliceous at a shallow depth than on the surface, and trial shafts might be sunk with good prospects of finding payable ore.

Bog Ore.—An impure iron-alumina-manganese ore occurs in the flat coal-measure country north of Currajong Creek, often forming a surface deposit 2 feet thick over considerable areas. The deposit is most likely a residual one, formed by the decomposition and leaching of a now denuded cover of basalt. There is no use for such ore just at present, though a demand may arise at any time for any of the metals contained in it.

KALLIWA.

Portion 5v, *Kalliwa*, is on the south-western side of Kalliwa Creek, 4 miles above the Burnett River, and 23 miles south-south-west of Gingin. In the cultivation of a small plot of ground on this portion, numerous blocks of manganese dioxide and silicate, together with stained slate, were found. Nothing can now be seen *in situ*, and the ore is not of good enough quality to warrant prospecting work even if there were any prospect of there being a large deposit here. Besides, the distance to a railway (14 miles either to Mount Perry or Degilbo in a straight line), and the roughness of the intervening country, would effectually prevent the present exploitation of any deposit of ordinary size.

DEGILBO.

Portion 54*v*.

Boulders of manganese ore occur over a width of 1 to 4 feet, on an east and west line, for a distance of 15 yards, in about the centre of the western part of 54v, Degilbo. Two tons of ore obtained some months ago averaged 69 per cent. manganese dioxide. A sample of the best ore now on the surface assays (Government Analyst):—

Manganese	52.0	per cent.
Available manganese dioxide	68.0	„
Silica and insoluble ...	6.5	„
Phosphorus	0.08	„
Sulphur ... trace, less than	0.01	„
Iron	1.7	„

This is a very good result, and with hand-picking, it should be possible to bring the percentage of dioxide up to 70 per cent., the minimum accepted at Mount Morgan.

The country rock is slate, but on the northern side of the outcrop jasperoid occurs, with bunches of manganese ore.

The cartage to Degilbo Railway Station (3 miles) costs 3s. 6d. per ton.

Other small bunches of good manganese ore are found in the slates at the northern end of the old Mineral Selection 2307 (on which the Commonwealth Mine is situated), a quarter of a mile west-south-west of the above.

WARWICK.

Mount Gammie lies 5 miles west-south-west of Pratten, and about 1½ miles east of Thane's Creek. The summit is 2,200 feet above sea level, and 800 feet above the general level of the surrounding country. The manganese deposit is on the ridge top, 10 chains south, a little east of the trigonometrical station on the summit, and is reached by a timber track from the Gladstone Mine. It is only a couple of miles from the proposed Thane's Creek station on the Warwick-Goondiwindi Railway, now in course of construction; so that, in the event of the ore being worked, cartage would not be a heavy item of expenditure.

The country rock is sandy clay slate and quartzite, striking a little east of north, while the trend of the ore body, which dips to the east, seems to be generally nearer north and south. It is said that only three blocks of ore outcropped, and no other outcrops are known in the vicinity, though strong stains are very prevalent in the Big Hill adit, 2 miles to the north-north-east.

Over twenty years ago an open cut 6 feet wide, 6 feet deep, and half a chain long, was made in search of ore. At the northern end of the cut there is a great development of quartz, little or no manganese ore, and no jasperoid, but pinkish cherty quartzites. Eight years ago a shaft was sunk at the southern end, to a depth of 15 feet, to test the most promising part of the deposit. Four tons of ore was obtained, with some difficulty, and sent to Sydney, but the contents were not reported.

In the shaft is 6 feet of manganiferous rock, but veins and stains of the mineral extend out into the adjacent country, sometimes for several feet. A large amount of quartz occurs as bunches in the same formation. About a quarter of the formation is manganiferous, but only about a quarter of that is good ore. It is thus evident that special cleaning machinery would be necessary in order to work the ore. The ore occurs as bunches up to 50 lb. in weight, surrounded by decomposed country. A few tons of comparatively poor ore now lie on the surface, the best material in which assays (Government Analyst):—

Manganese	48.9 per cent.

There certainly seems to be a slight improvement in depth, so that the deposit is well worth prospecting.

LIONEL C. BALL,
Assistant Government Geologist.

Brisbane, 23rd December, 1903.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

(B. DUNSTAN, F.G.S., GOVERNMENT GEOLOGIST.)

PUBLICATION NO. 224.

THE CHARTERS TOWERS GOLDFIELD.

NOTES ON THE MAIN REEFS.

WITH SIX PLATES.

BY

WALTER E. CAMERON, B.A. (Cantab.),
ASSISTANT GOVERNMENT GEOLOGIST.

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THE CHARTERS TOWERS GOLDFIELD.

NOTES ON THE MAIN REEFS.

◆

I.—GEOLOGY.

Previous Descriptions.

The geology of the reef systems of the Charters Towers Field has never been described in any detail, and the briefness of my visit, together with the fact that attention had to be paid mainly to the question of the requests for assistance from a number of individual mines, did not allow of more than a very cursory view being taken of the geological structure of the field.

The main gold-bearing reefs lie within an area some 2½ miles in length in an east and west direction by about a mile in width in a north and south direction, the chief producers having a more or less east and west strike and northerly dip.

The general geological features of the field were described by W. H. Rands and A. Gibb Maitland (then members of the geological survey staff) in the Annual Report of the Geological Survey for the year 1892. No geological work has been done on the field since their visit, and as their descriptions of the main outlines of its geology are not easily accessible, they are given here in full.

Mr. Rands thus describes the features of the western portion of the field:—

> The portion of the field on which I was specially engaged lies to the west of a line, drawn in a north and south direction, through the Racecourse.
>
> The greater part of this area is composed of the ordinary granite of the field, a rock which, in places, passes insensibly into a coarse diorite; this feature is more noticeable on the eastern end of the field.
>
> The granite is hornblendic, and contains very little mica. Neither this, nor any of the other rocks of the field, has yet been petrologically examined. This will be done, and the results will be published in a final report.
>
> The granite is intersected by two classes of dykes; one composed of basic and the other of acidic rocks.
>
> The majority of the basic dykes on the western portion of the field have a general bearing of about north-east and south-west, or at right angles to the general bearing of those on the eastern portion. Some of these are very persistent. I traced two parallel dykes for a distance of over one and a-half miles, and they probably extend much further, as towards the south-west I ceased to trace them on coming to the boundary of the map, while to the north-east they were lost on getting among the town blocks, where naturally much of the surface is made-ground. Others could be traced for a mile in length.

Another series of these basic dykes runs in a more or less northerly direction. The only evidence bearing on the relative ages of these two series of dykes is that in the grounds of the Girls' State School, on the East Mexican lease, where a north and south dyke faults two other dykes running in a north-easterly direction. It is probable, therefore, that the whole of these north and south dykes are the more recent.

There is an instance, near "Matlock," where one of the acidic dykes intersects a mass of diorite, and is itself intersected by a diorite, showing that diorites of two distinct periods occur on the field.

The dykes are often lost at the surface for some distance, and then crop up again in the same line, so as to suggest that the dykes are continuous. Where this has occurred, their probable continuation is shown on the map in broken lines.

The composition of these dykes varies considerably; but, pending a more minute petrological examination, they are classed together on the map, and distinguished by the letter *d*.

The acidic dykes consist chiefly of granite and felsitic rocks. The granite is very felspathic, and often contains large blebs of quartz and white mica, with little or no horneblende. These dykes are not so persistent in length as the basic dykes, and are very much more branched and irregular in shape. The longest distance I could trace one of these was about a quarter of a mile. They have no regular bearing, but run through the granite in all directions.

The acidic dykes are, in all cases on the western portion of the field, intersected by the basic dykes, and are consequently of an earlier date than the latter. They are coloured red on the map, and distinguished by the letters *g* and *f*. Some altered igneous rocks, of a serpentinous character, occur near the north-west part of the Public Park Reserve. Dykes of much altered igneous rocks occur in various parts of the field. These rocks are distinguished on the map by a blue colour, and the symbol *n*.

There is a large area of granite between the eastern and western series of dykes, which, so far as can be gathered from the surface indications, is practically free from dykes. In this area are situated some of the richest mines, such as the Brilliant, Victory, Victoria, &c. The underground work may of course prove the existence of dykes here, that are not seen at the surface; and it is impossible, until that work is done, to say what effect, if any, the dykes have on the auriferous character of the reefs.

On the north-western portion of the field there is a large wedge-shaped mass of slates, which dip steeply in a north-easterly direction. These slates run out to a point near Boundary street, just north of the Hospital grounds. These are the oldest rocks on the western portion of the field. The quartz-schists, on the eastern portion, are probably older; but without a more extended survey, it would be impossible to speak with certainty. These beds consist of mica-slates, with layers of quartzite, and a few patches of limestone. The limestone is highly crystalline, and is, in parts, coloured brown with oxide of iron. In the three places where it occurs, the limestone is right in the midst of a diorite, which is intrusive in those sedimentary rocks. A small tongue of diorite in one place cuts into the limestone, showing that the diorite must be intrusive in it, and that the limestone is not a vein.

Dykes of diorite run out from the larger masses into the slates in a south-easterly direction, following, for the most part, the line of strike of the slates, but often cutting across the direction of strike.

Another mass of slates, of similar character, occurs near the south-west corner of the Racecourse Reserve; they continue across the railway line down as far as the Queen's Consolidated and the United Queen's Consols leases. These slates are also intersected by dykes, generally running parallel to the direction of the strike of the beds.

A third very small patch of slates, which are highly micaceous, occurs close to the Rainbow road, on Lease No. 1229.

Some large alluvial flats occur in places along the watercourses.

Mr. Maitland thus describes the eastern portion of the field—

The portion of the field which had been allotted to me may be defined roughly as that district lying to the east of a line running north and south, commencing from the western corner of the Racecourse, and bounded on the east by the waters of Gladstone Creek.

The mapping of this portion of the goldfield turned out to be much more difficult than had been anticipated, owing to the complexity of the geological structure. This work occupied me until January of the present year.

As the Report and accompanying maps have not yet been published, the following is a *résumé* of the geological structure of the portion of the field which fell to my share:—

By far the larger portion of the ground is composed of granite, and a very coarse-grained rock, containing hornblende, mica, and a triclinic felspar—a quartz-diorite. It was found quite impossible to draw any line separating these two distinct rocks. Hence both have been delineated on the map by the same colour and symbol. An examination, yet to be undertaken, of the geological structure as revealed by mining operations, may yield valuable information as to the relation which the granite and coarse diorite bear to one another. In the absence of chemical analysis and miscroscopic examination, no further details can at present be given regarding these rocks.

The granite penetrates those sedimentary beds which form the lesser portion of the ground.

The sedimentary rocks consist, for the most part, of indurated siliceous rocks (approaching very closely to quartzites), sometimes very micaceous. Wherever they are exposed, the beds are seen to be either vertical or inclined at high angles.

In these indurated sedimentary rocks, in the vicinity of the area which I mapped, the alteration has not proceeded so far as to cause the rocks to be placed in the category of the metamorphic, using this latter term in its strictest sense.

The contrary appears to be the case with the quartzites or quartz-schists, which occupy only a very small portion of the western end of the country in the vicinity of Gladstone Creek. These rocks are distinctly marked off from the rest of the beds, not only by the extent to which alteration has been carried and the physical characters of the rocks themselves, but also by the fact that similar rocks are seen to be interbedded with the chief masses of sedimentary rocks.

These siliceous rocks may be merely part of the sedimentary series of other portions of the field, or they may be of older date. Detailed mapping, carried over a much larger area, is the only method by which the true relation of the two series can be made out.

The area in the vicinity of Gladstone Creek is the only part of the field embraced within the limits of the survey in which these presumably more ancient rocks have been detected.

The most important feature in the structural geology is the system of dykes which occupy a very large area in the eastern portion of the district, and extend to the south-east into country far beyond that which it was my duty to map.

On petrographical grounds, the dykes are divisible into two totally distinct series—a basic and an acidic.

The basic dykes are remarkable from the fact that, so far as it was possible to carry my survey, they had no apparent connection with any visible deep-seated mass of rock of similar composition, unless some relation exists between the coarse diorite and the dykes. This, however, is a subject upon which light may be thrown when the underground survey of the field has been carried out.

The longest dyke has been followed north-west for a distance of about three-quarters of a mile as far as Gladstone Creek, after crossing which it stretches away beyond the limits of the country examined.

When the positions of the various dykes are laid down upon a map, it is found that there are two distinct sets or systems, each approximately at right angles to the other. The individual dykes of each set have an approximate parallel trend.

The rocks of which these dykes are composed are all basic compounds. They vary very much in texture in different parts of the area, and even in different portions of the same dyke. At one end of the series are rocks of very fine grain, and at the other very coarse-grained rocks. Other varieties are markedly porphyritic. To have distinguished the different varieties of basic dykes on the map would have necessitated microscopic work being carried out hand in hand with work in the field, which was impracticable. A selection of the most representative types has been prepared for microscopic study, and will be fully dealt with in the final report.

Wherever an opportunity of examining a section of the dykes presented itself, it was found that they were vertical, or nearly so.

The breadth of the dykes, as would naturally be expected, varies very much in different places, but in no case was the width exposed on the surface very great.

In a few cases there are what appear to be interruptions to the lateral continuity of the dykes and their subsequent resumption upon what seems to be the same line.

A few of the dykes gave off lateral branches which, in some cases, connect parallel veins. In other places, portions of the rock traversed by the dykes are caught up in the centre of the mass.

The intersection of the two rectangular sets of dykes is easily seen where the two rocks are of different textures.

The acidic dykes, though presenting somewhat similar structural features to those above described, have several important points of difference.

The dykes have the same general composition as granite, and belong to the elvanite family. In different portions of the same dyke the composition varies very much; at one place the rocks may present all the characters of a microgranite; at another all those of aplite, with pegmatitic varieties. The absence of hornblende distinctly marks off these dyke rocks from the main mass of granite of which this district is composed. These elvanites are, in all probability, offshoots from some granitic mass not seen within the ground embraced by my work.

The acidic dykes have much more sinuous courses than those of the basic type. They are neither so uniform in their thickness, nor have they such a persistent trend. These very irregular dykes have numerous branches, and what may be termed lateral excrescences. They intersect some of the basic dykes, and are intersected by others.

To the north of Millchester are certain other altered dyke rocks, not referable to any of the varieties known to exist on the field. These will be fully described at a later date.

A feature common to the two sets is that the dykes appear to end almost abruptly when they come in contact with the sedimentary rocks.

Evidence is seen of the shifting of the dykes by faults; but in no case does the shifting on the surface appear to be very great. In the case of vertical dykes, however, this does not prove that the displacement is a small one.

What effect these dykes have upon the reefs and their contents can only be ascertained after the examination of the underground workings has been made.

The banks of the most important creeks are skirted by a width, more or less great, of recent superficial deposits. These also have been delineated upon the map.

The map of the surface geology of Charters Towers resulting from the field work of Messrs. Rands and Maitland was published in 1894, and showed the boundaries between the altered sedimentary rocks and the intruding granite, as well as the positions of the numerous acidic and basic dykes with which the field is intersected.

A later edition, in 1898,* showed also the underground workings on the various reefs as far as they had been carried out at that time. The detailed petrography of the field was, however, never written, nor any description of the character of the reef systems or of the geological structure as revealed by the mining operations.

SEQUENCE OF THE IGNEOUS INTRUSIONS AND OF THE FORMATION OF THE VEINS.

Judging by the mapping and remarks of Messrs. Rands and Maitland, and by the exposures now accessible in the mine workings, the general sequence of formation of the various igneous rocks, to the presence of which the occurrence of the gold veins is no doubt attributable, appears to be as follows:—

(1st) The intrusion of the sedimentary beds by a mass of hornblendic granite, and the alteration of those beds into slates and schists by the pressures to which they were exposed during this intrusion.

(2nd) The intrusion of this older granite and the adjoining altered sedimentary rocks by irregularly-shaped and irregularly-disposed felsitic dykes. These are probably apophyses from a second magmatic mass of acidic character, the greater bulk of which solidified at some depth below the present surface of the country.

(3rd) The intrusion of all the above-mentioned rocks by dykes of a more basic character (diorites?). On the western end of the field these basic dykes have a general parallelism in a N.E. and S.W. direction, but on the eastern end of the field they run more nearly from N.W. to S.E. They are probably off-shoots from a mass which has been exposed over a large area on the north-western corner of the field, and which has been mapped by the previously mentioned observers.

Subsequently to the solidification of these three types of igenous rocks occurred the fissuring which allowed of the ascension of the quartz- and metal-bearing solutions from which the present reefs were formed. These fissures cut through sedimentary beds, granitic rocks, and acid and basic dykes indifferently, and their filling with quartz and metallic minerals represents the last traces of vulcanism apparent in the field.

The relation of the quartz reefs to the diorite dykes in point of time of formation is clearly shown by the underground workings of the Brilliant and Brilliant Freeholds Mines, where they cross a large diorite dyke striking from N.W. to S.E. The position of this dyke is shown in broken lines running parallel to the Brilliant Freeholds underlie on the 1898 edition of the geological map of the field. As the levels of these mines are followed to the west, they come to a position where the stoping ends, and diorite takes the place of the stoped ground overhead. At first it would appear as if the diorite had intruded the granite subsequently to the formation of the reef, and had thus cut the reef off. More detailed examination, however, shows that the reef quartz occurs right through the diorite dyke (which is in places up to 40 ft. in thickness), but that subsequent movement of the country along the plane of weakness formed by the junction of the diorite dyke and the granite has shifted the reef in the diorite to a higher position. After driving through the diorite and picking up the reef in the granite on the other side, the reef has been stoped back through the diorite at the higher level, and the anterior date of formation of the diorite is thus made apparent. In the workings on the Day Dawn reef in Mills's United numerous examples of dykes of diorite can be seen in the walls, completely cut off by the "formation" of the reef, while the continuity of the reef and "formation" is nowhere interrupted by these dykes.

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* Geological map of Charters Towers Gold Field showing underground workings. On a scale of 4 chains to an inch. Second Edition, 1898. (In six sheets.) G.S.Q. Publication No. 142.

INFLUENCE OF COUNTRY ON GOLD DEPOSITION.

Mr. Rands, in his report, says:—"There is a large area of granite between the eastern and western series of dykes which, so far as can be gathered from the surface indications, is practically free from dykes. In this area are situated some of the richest mines, such as the Brilliant, Victory, Victoria, &c. The underground work may, of course, prove the existence of dykes here that are not seen at the surface; and it is impossible, until that work is done, to say what effect, if any, the dykes have on the auriferous character on the reef."

A study of the plotting of the underground workings on the geological map of the field published subsequently to the above remarks points to the conclusion that, though the "diorite" dykes appear to have little, if any, influence on the gold contents of the reefs, the ground underlying the mapped outcrops of the felsitic dykes has been markedly unfavourable to the deposition of gold, though in many cases the reef fissures have been followed right under these outcrops. The best examples of this fact are perhaps the poverty of the ground under the Day Dawn School Reserve and the Church of England ground, where dykes of this character are strongly in evidence on the surface, and where the surrounding payable ground has been mostly all stoped out. An examination of the map will show that in no single instance where outcrops of acid dykes have been depicted on the surface has the ground been rich enough below to allow of any extensive stoping being done. If these acidic dykes are the upper portions of apophyses from a larger mass which has solidified at some unknown depth below the present surface of the ground, the probability is that they increase in size with depth. The universally observed barrenness of the ground in their neighbourhood points to the conclusion that the rock of which they are formed was in some way unfavourable to the deposition of gold, and if this conclusion is correct it is interesting as a fresh example of the influence of country rock on the gold values of the veins occurring in it.

The occurrence of dykes of this character in the western and deeper portions of the Day Dawn Gold Mines lease possibly accounts for the poverty of the Day Dawn formation in this portion of the company's ground. The absence of such dykes, on the surface at least, in the ground lying to the north and west may thus allow of an alteration of conditions for the better as this ground is opened up.

II.—THE MAIN REEFS.

THE THREE CHIEF SYSTEMS.

The most important gold-bearing reefs of the Charters Towers field divide themselves into three classes, depending for their differences on peculiarities of occurrence which become apparent with only a very slight acquaintance with the field. The western end of the field is characterised by the Day Dawn reef occupying a fissure remarkable for the regularity of its bearing and dip over a length of some 6,000 ft. of workings, and to a depth of 3,000 ft. from its outcrop. The reef has been worked for payable stone for nearly 5,000 ft. along its course, and to a depth of 2,500 ft. from where payable stone was first struck at about 200 ft. down the Day Dawn P.C. underlie. The chief dividend-paying mines in which this ground has been worked, have been, passing from east to west, the Day Dawn P.C. working from the outcrop, and Mills's Day Dawn United blocking it off; then the Day Dawn Block and Wyndham, and Pfeiffer's Day Dawn Gold Mines blocking it off; to the west of these the Day Dawn Gold Mines. These mines have paid over £2,000,000 in dividends.

The strike of the fissure is nearly due east and west, and, as shown by the plotting of the underground workings, varies little from this direction throughout the entire length of the workings, except where here and there subsequent local movements have shifted it out of its course for a few feet only. The dip varies from 45 deg. to 60 deg., but vertical sections across the centre portion of the formation, worked in the Day Dawn P.C., Block and Wyndham, and Mills's United Mines show only slight variations from a ruling grade of about 50 deg. This well-defined and regular fissure appears, as far as can be judged by the reports of the older workings and the faces at present exposed, to have been filled throughout its entire length by the intrusion of a dark fine-grained igneous rock (diabase?). This rock is locally known as diorite. It has been crushed and sheeted by subsequent movements along the plane of the fissure, and this crushing has allowed of its infiltration by silica and metal-bearing solutions from below, and its metasomatic replacement by quartz and metallic minerals was thus given free vent.

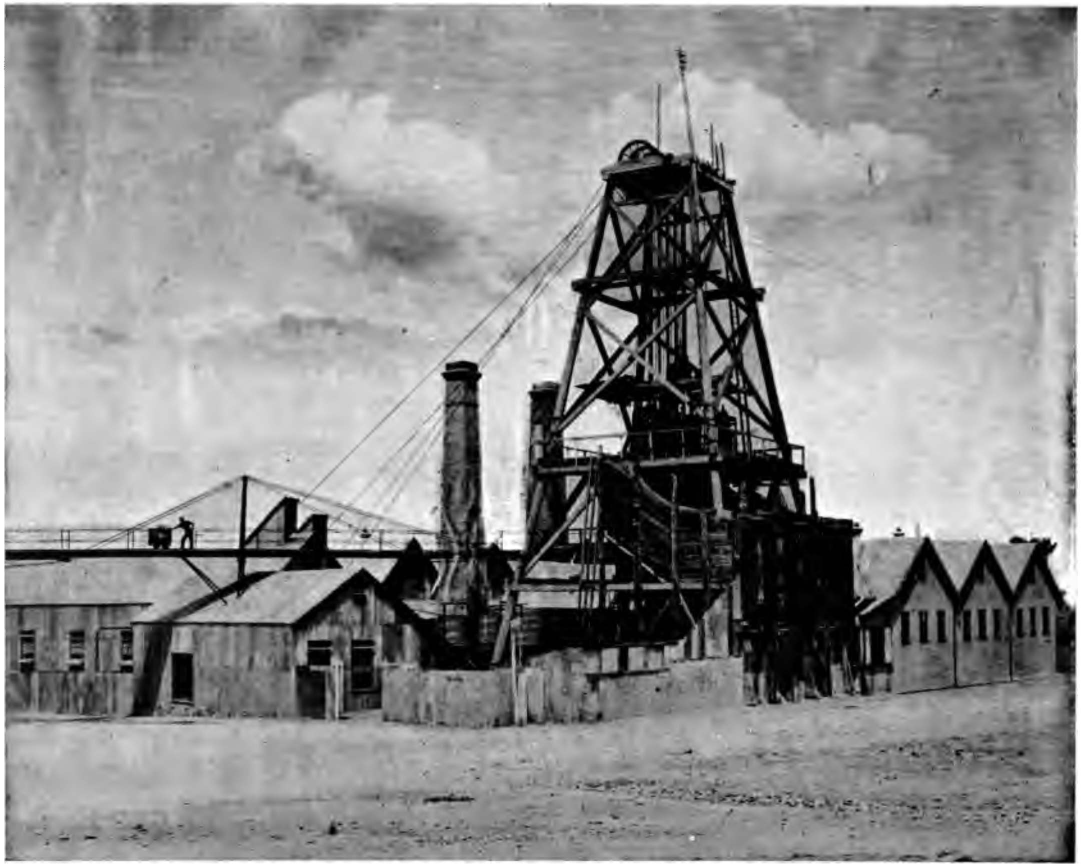
The average width of this "diorite" formation is from 4 ft. to 6 ft., but many places show widths of up to 20 ft. between the granite walls. Owing to the marked differences of character between the "diorite" formation and the granite walls, the latter are usually exceptionally well-defined. The remarkable regularity of this fissure both in strike and dip over the great extent of workings referred to above, would seem to imply that it could only have been formed by faulting or shearing on a large scale. A study of the detailed mapping of the numerous cross dykes shown on the geological map of the field by Messrs. Rands and Maitland would indicate, however, that any movement of magnitude of this character must have occurred prior to the intrusion of these dykes, and it may well be that, notwithstanding the great dimensions of the fissure, comparatively little differential movement of the walls actually occurred.

The eastern end of the field is characterised, in the first place, by a series of reefs dipping at flat angles (about 35 deg.) to the north-north-west, and showing considerable irregularity both in strike and in dip when followed from point to point. The most important producer in this system of reefs has been the Brilliant reef, while the Victoria hanging-wall and footwall reefs, the Victoria and Queen reef, and the Caledonia reef have also been important members of the series.

The ground over which these reefs have been worked covers an area of nearly a mile in length, in an east and west direction—*i.e.*, approximately along their strike—by about half a mile in width in the direction of their dip. They have afforded the bulk of the richer stone of the field, and, on account of their flatness of dip and the relatively small areas at this end of the field, it has been possible to attack them at numerous points simultaneously from comparatively shallow vertical shafts. They have thus been exhausted at a greater rate than would otherwise have been the case, and at present the visible supplies of stone in the easily accessible ground on these reefs are nearly exhausted.

The veins of this series do not show the regularity of course noticed in the Day Dawn reef, nor are they remarkable for the length of continuous workings on the one chute of stone. The Brilliant reef, however, has been worked over a length of nearly 1,500 ft. on some of the levels, and for a distance of nearly 3,000 ft. down the pitch of the chute. A study of the plotting of the underground workings points to the conclusion that these reefs are all the result of one main fracturing of the granite, the several veins being all more or less definitely connected with each other, and traceable

Plate II.



MILLS'S UNITED GOLD MINE, CHARTERS TOWERS.

THE LARGEST PRODUCER ON CHARTERS TOWERS FIELD.

Returns for 1908: Ore treated, 45,195 tons; value of product, £179,696; dividends, £75,000.

from one to the other. Their irregularity of strike and dip indicate that there was little displacement of the walls of the fissure in which they occur. The evidence on this point is confirmed in the case of the Brilliant reef by the occurrence of earlier formed quartz veins which have been cut through by that reef, but have not been shifted more than 2 or 3 ft. when followed from one side to the other of the Brilliant reef. None of these reefs apparently gave promise on the surface of the riches that they were subsequently found to carry at a depth, the Brilliant reef, indeed, having been first struck at a depth of 760 ft. in the Brilliant shaft. This shaft was merely a prospecting shaft being sunk to test the country, and the chute of gold was never worked higher than to a vertical depth of 600 ft. from the surface.

The "formation," or gangue, of these veins shows every indication that it has been formed by the alteration of the granite walls of the fissure by the replacement of its minerals by silica and metallic sulphides introduced in solution from greater depths.

Crossing these east and west veins at right angles and dipping flatly to the northwest are a series of reefs which proved very rich on the surface, and down to a vertical depth of about 600 ft., but which have not of late years added very much to the yield of the field. These reefs are represented by the Victory, the St. George, the Just-in-Time, the Maude St. Ledger, the Worcester Reef, and other small veins. They show a general parallelism, and were characterised, as far as could be judged from the few exposures seen by me, to be fairly tightly imbedded between hard and regular granite walls. They gradually decreased in width as they were followed down the underlie, and do not hold out much prospect of adding materially to the future output of the field.

THE WORKINGS ON THE DAY DAWN REEF.

At the surface, according to the generally accepted tradition of the field, the Day Dawn reef was nowhere payable, the shallowest payable stone having been met with at a depth of 200 ft. down the underlie of the Day Dawn P.C. shaft. The "chute" of good stone was at first only some 200 ft. in length. Below that point, however, the body of payable stone rapidly lengthened, till, at a depth of about 1,500 ft. from the outcrop, the reef was stoped continuously (except for the blank under the Church of England ground) for over 3,000 ft. along the course of the fissure.

On its western end this body of stone took the form of a long horizontal tongue, extending for some 2,000 ft. from the main body, and with a depth of some 300 ft. Barren formation was found both above and below this good stone in the workings of the Block and Wyndham and Day Dawn Gold Mines. These latter workings towards the west have exposed no further payable stone for the last 1,000 ft.

of their distance, though the fissure has been proved to extend still further by the workings of the Wallis's Day Dawn Company. In this ground it carries several patches of payable stone.

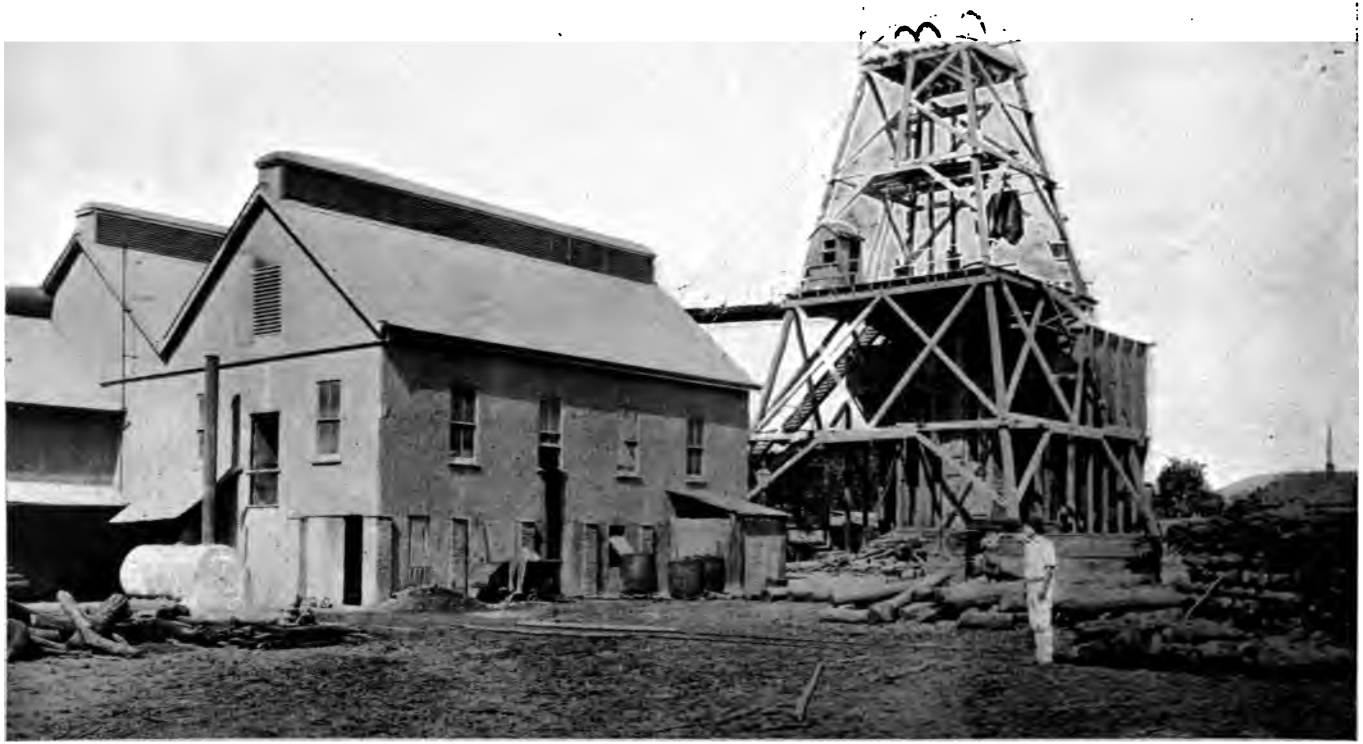
Below the western end of this horizontally disposed chute of good stone the Day Dawn Gold Mines Company have carried out a considerable amount of prospecting, but, so far, without success.

In the Day Dawn P.C., Block and Wyndham, Mills's United, and Pfeiffer's Day Dawn ground the main body of the payable "chute" on the Day Dawn fissure has been stoped out for a length of about 1,500 ft. and to a depth of about 2,500 ft. from the surface. Below this level no large bodies of payable stone have been found up to the present, though two underlie shafts have been sunk for some distance below. These two underlie shafts—viz., Mills's United and Pfeiffer's Day Dawn—are situated some 1,150 ft. apart, the former having reached a vertical depth of 2,170 ft. and the latter of 2,446 ft. The failure of the latter underlie (the most western of the two) to develop any payable bodies of stone, combined with the poor results from the lower workings of the Day Dawn Gold Mines still further to the west, has had a depressing effect on the hopes formerly entertained as to the prospects of the deeper western ground on the Day Dawn fissure. It was on these hopes that the enterprise of Plant's Deep Mines shaft was initiated, to test this deeper ground, and the hanging up of that shaft was probably to some extent a result of the want of success of these two mines. The Day Dawn fissure, however, shows no sign of fading out in this direction, and it is quite conceivable that the comparative barrenness of the formation in the present western workings is due to local causes which will give way to better conditions as prospecting is further advanced.

On its eastern margin the main body of payable stone of the Day Dawn reef was worked by the Day Dawn P.C. and Mills's United Companies, the former working the shallower ground down to about 900 ft. from the outcrop, and the latter blocking off the former mine in the deeper ground. Followed in an easterly direction the good stone did not go further than a point about 500 ft. from where it was followed down by the P.C. underlie. In Mills's United workings (below the P.C. ground) the eastern extension of the workings passed into the same unpayable ground as they were extended into the Day Dawn School Reserve. The levels below the School Reserve, however, at a depth of about 2,000 ft. from the outcrop, after passing through a poor zone about 200 ft. in length, gradually worked into payable stone. This stone has now been followed by driving the No. 7 East main level into the adjoining New Brilliant Freeholds property, the stone improving rapidly in quality as that property was approached.

The value of the stone in the New Brilliant Freeholds ground is shown by the fact that the first 355 ft. of driving on the No. 7

Plate III.



PFEIFFER'S DAY DAWN GOLD MINE, CHARTERS TOWERS.

main level gave a return of over £5,000 worth of gold. This level had been driven, at the end of the year just closed, to a distance of 700 ft. from the boundary with Mills's United. The remaining 345 ft. did not disclose such profitable stone, but the fissure is apparently still continuing, and the opening up of the reef by a footwall crosscut from the Brilliant Freeholds shaft, which should meet this level at a point about 250 ft. further east, will permit of a more expeditious exploration of the eastern extension of the reef than is at present possible. The New Brilliant Freeholds Company estimate that with this level and that below, now driven 304 ft. from Mills's United boundary, they have developed 50,000 tons of stone, worth £5 6s. per ton. Whether this estimate prove correct or not there cannot be any doubt that the finding of this body of stone after driving through 200 ft. of barren ground has considerably enhanced the prospects of finding payable stone on the Day Dawn fissure under the eastern section of the field.

About 300 ft. from the eastern boundary in Mills's United Mine the Day Dawn Reef has sent out a hanging-wall reef, which has been followed in four levels to the boundary with the New Brilliant Freeholds ground, and which showed up to 6 ft. of fair stone along the boundary. As this reef is apparently only an off-shoot from the main reef, it may not persist with the same width to any great distance from its junction with the main reef. It, however, forms an additional prospect for the nearer mines along the Day Dawn line.

Reviewing the Day Dawn Reef as a whole, therefore, we see that it occupies a remarkably well-defined and regular fissure, which has been certainly followed over a horizontal distance of more than 6,000 ft., and has been worked for payable stone for a length of nearly 5,000 ft., and to a depth from its cutcrop of 2,500 ft., though at the surface its early development is said to have been nearly abandoned, on account of the poverty of the stone. The amount of dividends paid from this reef is recorded as over £2,000,000, while the amount of money distributed in wages for mining and treatment of the stone must have been very considerable. As far as I was able to see, the limits of the fissure to east and west and in depth show no sign of being so close as to preclude the possibilities of further payable bodies of stone being found, and the most important matter that the mining men of the field have now to deal with is that further prospecting of the reef may be carried out with the least possible expenditure of money and time.

Prospecting Work on the Day Dawn Reef.

Below the vertical depth of 2,000 ft. the results up to the present have not been as promising as were expected from the splendid returns obtained above that level. In the sinking of Mills's United and Pfeiffer's Day Dawn underlie shafts is being done all that can be done to prospect this deeper ground below the main productive ground, and the fact that both are still in the characteristic Day Dawn formation lends colour to the hope that another payable body of stone will eventually be found in this deeper ground.

Towards the west the Day Dawn Gold Mines and Wallis's Day Dawn are gradually extending their workings, the former at a vertical depth of nearly 2,000 ft., and the latter in the shallower ground some distance further west. The Day Dawn Gold Mines has been in barren ground for some considerable time; while Wallis's shaft, though it has met with some patches of payable stone, has not as yet come upon sufficient ore to repay the owners for their outlay in opening up their mine. The expeditious testing of the deeper ground beyond the workings of the Day Dawn Gold Mines is much to be desired in the interests of the field as a whole. It is a venture which, for its satisfactory accomplishment, will require the expenditure of a considerable sum of money in proper equipment, and in preliminary dead work in the sinking of a deep shaft and driving exploratory levels. It cannot be satisfactorily undertaken by a small company restricted to a limited area of ground, or with a working capital insufficient for the proper carrying out of the undertaking.

The most promising prospect for the near future, however, is that offered by the expected continuation of the gold-bearing stone towards the east, as this will bring the reef into that ground, which has already been a magnificent source of wealth in the workings on the shallower lying Brilliant Reef. The Day Dawn fissure in all probability extends as far east, at least, as the Brilliant P.C. shaft—*i.e.*, to a point 1,400 ft. east of the easternmost point to which it has been followed in the Brilliant Freeholds No. 7 main level. A formation is reported to have been met with at 1,435 ft. in the Brilliant P.C. shaft, and the direction of strike of this formation, as given in a drive depicted on the plans of this mine, corresponds with the bearing and depth that would be expected from the Day Dawn fissure at this point. This formation at the bottom of the Brilliant shaft is reported to have carried no payable stone. The fact, however, that a large area of ground to the north of this shaft proved exceptionally rich on the overlying Brilliant formation warrants the hope that the Day Dawn fissure may also prove a valuable gold producer over this area.

At present the eastern extension of the Day Dawn Reef is being prospected at five different points within a distance of 2,000 ft. from the present workings in the Brilliant Freeholds No. 7 main level; while a sixth venture—viz., the sinking of the Queen Cross shaft—is expected to meet the reef at a distance of over 4,000 ft. from the present workings. This latter shaft should now have only about 200 ft. to go to meet the Day Dawn formation, if it continue so far east with the same regularity of strike and dip as it has hitherto

Plate IV.

shown. Considering the fact that the surrounding ground has already yielded magnificent returns from higher reefs, and that the sinking of the shaft would be prospecting the ground for deeper formations, the sinking of this 200 ft. would certainly seem worth the expenditure involved, were it not that the economical prospecting of the Day Dawn formation, if found, and its economical extraction when found, might easily be frustrated by any want of agreement between the companies holding the surrounding ground. The first desideratum, therefore, for a thorough prospecting of this eastern ground for the Day Dawn formation, is an amalgamation of the different interests represented by the numerous small and irregular areas in the neighbourhood of this shaft.

Of the five points of attack, situated within the first 2,000 ft. from the present most easterly workings on the Day Dawn Reef, the most important, because the nearest and probably the first that will give definite results, is the cross-cutting from the Brilliant Freeholds shaft. This shaft is situated about 260 ft. east of the end of the No. 7 main level, and is sunk to below the 1,500-ft. level—*i.e.*, to the depth at which a crosscut south is expected to cut the extension of that level. The cross-cutting is expected to be about 170 ft. in length, and is now in progress.

A few hundred feet east of this crosscut the Brilliant P.C. Company is reported to be cross-cutting back from their workings on the Brilliant Reef, and at about the same vertical depth. With the ventilation afforded by the breaking through of the Freeholds' crosscut and the probable extension of their level to their eastern boundary, this crosscut of the Brilliant P.C. should allow of the exploration of a large portion of the Brilliant Company's ground. It may also afford funds for the repair of their vertical shaft (burnt out by the fire of 1904), situated some 700 ft. further east, or for the sinking of a new shaft nearer the outcrop and more in the centre of the property.

About 800 ft. east of the Freehold shaft, but considerably further to the dip, the Brilliant Block shaft is being sunk, and is expected to meet the Day Dawn formation at a depth of about 2,040 ft. At the end of February, 1909, this shaft was down about 1,580 ft., leaving probably under 500 ft. to sink. As this shaft lies well to the west of a line drawn north and south from the Brilliant shaft, and as there seems every probability that the Day Dawn fissure will be found to extend as far east as the latter shaft, the prospects that this shaft will also meet the formation seem fairly hopeful. Whether the formation will carry payable stone or not at this point is, however, a much more problematical question, and it is doubtful whether it would not have been better to have waited further developments in the Brilliant Freehold property to the west, and to have devoted the money (probably some £10,000) which has been expended in sinking, to driving from that property when the workings should be extended far enough east for that purpose.

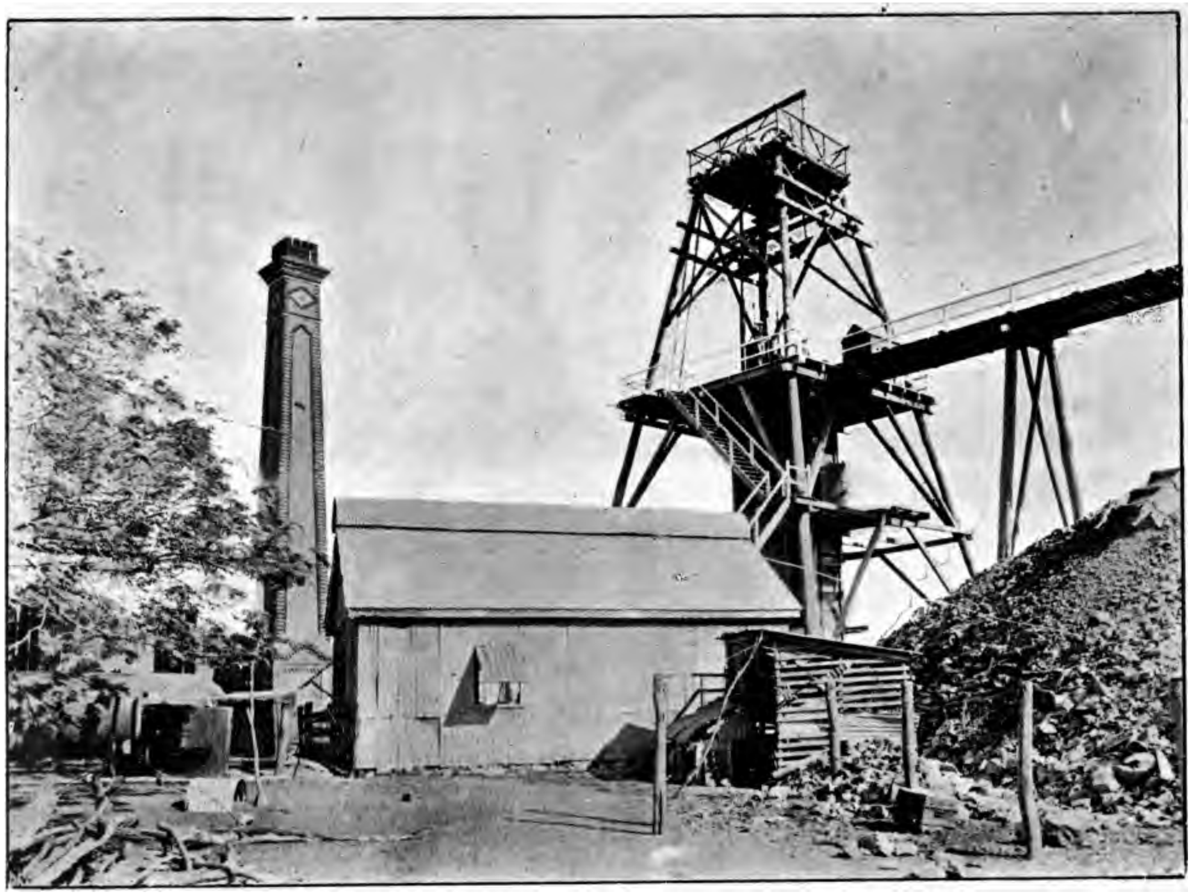
Another 800 ft. east of the Brilliant Block shaft, and still further to the dip, the Brilliant and St. George shaft is being sunk to test the continuation of the Day Dawn Reef. If the reef continue this far and keep the same course, it should be met with here at a depth of about 2,120 ft. About the end of February last the shaft was reported to have reached a depth of about 1,336 ft., leaving another 800 or 900 ft. of sinking to be accomplished. The prospects that the Day Dawn formation will be found by this shaft are somewhat more problematical than in the case of those situated further to the west. The property to be worked from this shaft has, moreover, on an average, a length of only some 400 ft. along the strike of the reef, being hemmed in on the western side by a portion of the Brilliant ground, and on the eastern side by the Phœbe Mine. It is to be regretted that some amalgamation of the ground in the neighbourhood of this shaft could not have been made before the expenditure of sinking the shaft (probably some £10,000) was undertaken, and the economical prospecting and working of the whole of the ground in the neighbourhood have been thus assured.

Almost due south of the Brilliant and St. George shaft, and accordingly about 1,900 ft. east of the present most eastern workings on the Day Dawn Reef, Clarke's Brilliant and Day Dawn shaft is being sunk to prospect the eastern extension of the reef in the shallower ground. The shaft is already down 1,040 ft., and should be approaching the reef if it keeps its regular strike, and dip this far to the east. This shaft is in an awkward position, as it is hemmed in to the north and to the west by the Victory Company's ground, so that it will be impossible for it either to drive on the reef to the west or to sink to any distance on the underlie.

RECENT DEVELOPMENT ON THE BRILLIANT REEF.

The Brilliant formation has been followed down, as an easterly pitching chute of irregular outline with a maximum width of about 1,500 ft., from the point where it was first met with at a depth of 760 ft. in the Brilliant P.C. shaft, for a distance of over 3,000 ft. to the lowest workings. At the bottom of the Brilliant Extended underlie, now at a vertical depth of 2,800 ft. from the surface, the sink still shows payable stone. On the eastern side of this chute the ground becomes broken up, and several vertical shafts and drives have failed to disclose anything in the nature of a well-defined fissure that holds out much prospect of leading on to payable bodies of stone. On the western side the Brilliant Deep Levels workings have developed large bodies of unpayable stone at a vertical depth of 2,000 ft. from the surface, having driven on this class of material for over 1,500 ft.

Plate V.



BRILLIANT DEEPS GOLD MINE, CHARTERS TOWERS.

ate VI.

ENTRAL GOLD MINE,

14,251 tons, for a return value

Recently, however, their western drive has developed what is reported to be over 2½ ft. of heavily mineralised stone, a crushing of 100 tons of which is reported as having returned over £9 per ton. Without an inspection of this development it is difficult to form any opinion as to its character, or as to its bearing on the prospects of another "chute" of payable stone on the Brilliant line of reef. There seems no reason, however, why such another "chute" of stone should not occur, and this development may prove the means of adding considerably to the productiveness of the surrounding properties.

CONCLUSION.

Taking the field as a whole, therefore, the most hopeful prospect of continued productiveness would seem to lie in the development of the eastern ground on the Day Dawn fissure, and the activity of the mines at this end of the field in sinking their shafts to develop this ground will demonstrate within a very short time whether this prospect is likely to be realised or not. In this connection, it has been pointed out that an amalgamation of interests would in many cases be an advantage, as it would spread the burden of expensive exploration over a greater number of shareholders, and would allow of the more economical mining of the ground if anything should be found. The smaller areas, which were perhaps suitable for the more flatly dipping and richer reefs, now practically exhausted, are quite unsuitable where expensive prospecting has to be undertaken before payable bodies of stone can be expected to be developed.

The western ground also affords prospects which, however unpromising at present, may at any time brighten sufficiently to allow of a more energetic development of this end of the field.

On the Brilliant line of reef the recent find of good stone at a depth of over 2,000 ft. in the Brilliant deep levels mine, and nearly 1,000 ft. from the nearest payable stone on that reef, may lead to a very considerable addition to production.

Brisbane, 20th March, 1909.

By Authority: ANTHONY JAMES CUMMING, Government Printer, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.
(B. Dunstan, Government Geologist.)
PUBLICATION No. 223.

The Starcke Goldfield.

WITH TWO MAPS AND THIRTEEN FIGURES.

BY

LIONEL C. BALL, B.E.,
ASSISTANT GOVERNMENT GEOLOGIST.

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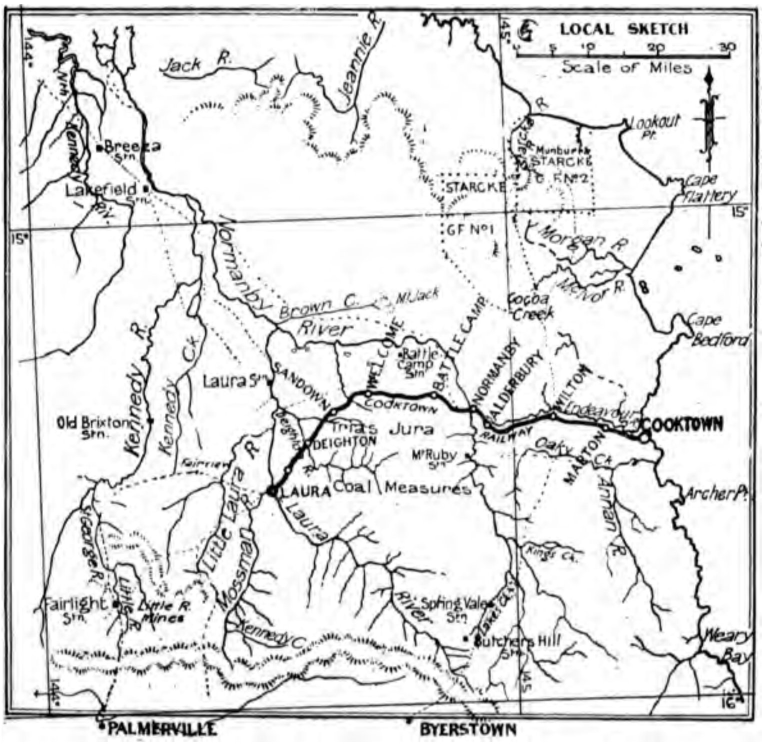

MAP 1. LOCALITY PLAN.

THE STARCKE GOLDFIELD.

◆

PRELIMINARY.

An account (¹) of the more important workings on the Starcke was published by Mr. Cameron, of this Survey, in 1906; and the desire of the people of the North for a more extended report is the reason for the length and detail of the following descriptions of an almost abandoned field.

While in Cooktown I was privileged to glance through the MS. of an essay by Mr. Dick, on the mineral wealth of the district. This had taken a prize at the local show and the committee of that institution had thought of publishing it in pamphlet form. It contains much of interest as to the early days of the fields, but is considerably marred by frequent personal reflections on other workers. Mr. Dick's estimate of the output of certain of the Starcke mines is much greater than those of the Warden.

My examination was made under the great disadvantage of there being so few mines working that it was difficult to form an opinion of the nature of the reefs below ground, while the payable portions at the surface had long been removed. Without the assistance of Messrs. Stuckey and W. Webb not a fraction of the workings described below could have been located. The great heat experienced during the latter part of the survey told against reliable and detailed work, which had in any case to be hurried owing to the scarcity of horsefeed in the district. Mr. R. Macdonald, the junior assistant, accompanied me in the field.

GEOGRAPHY.

Starcke Goldfield No. 1 was proclaimed in 1895 to have an area of 210 square miles. It extends from the head of the McIvor River on the south to the lower part of the Starcke River on the north. Starcke Goldfield No 2, proclaimed three years later, has an area of 222 square miles, and lies on the north-east of the No. 1 field. The only

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(¹) Some Goldfields of the Cape York Peninsula. By Walter E. Cameron, B.A., Assistant Government Geologist. Bris.: By Auth. 1907. (G.S.Q. Publication No. 209.)

mines on the former are those of Cocoa Creek, the field having been proclaimed prior to the correct location of the Starcke workings, now included in the latter.

Munburra, the surveyed township site, where the post office, store, and battery are situated, is on the No. 2 Goldfield, 43 miles north-north-west from Cooktown, but the distances by road and track are 60 miles or 75 miles (according as the Cocoa Creek or McIvor route is taken). It is possible to drive to the McIvor, but beyond that there is only a bridle track. Stores are generally shipped from Cooktown to the mouth of the Starcke River, and are thence taken by dray to Munburra, which is 10 miles distant from the landing.

Topography.

The topography of this area is much diversified. The Starcke Valley occupies the site of an old mountain tract, of which the coast range hills are the stumps. It has a width at Munburra of between 4 and 5 miles. To the west of the Starcke River is a sandstone-capped plateau, which presents well-marked escarpments to the valley and has a gentle westward slope to the Normanby River. The mountains at the head of the Starcke, however, have more often the form of "mesas," which bear witness to the former extension of the tableland in this direction. The streams have cut rapidly and deeply into the underlying slates, and the hills and ridges are consequently very precipitous. The divide between the river and the sea on the north-east has lost almost the last remnant of its former sandstone cap, and exhibits the characteristically rounded and conical forms of slate country.

Munburra has an elevation of about 150 ft. above sea level, the Coast Range rises to 900 ft., and the western plateau to 1,100 ft.

HISTORY.

Gold was discovered in the valley of the Starcke by two prospectors, Cairns and Bowden, at the end of 1890. The alluvial in the gullies at the head of Diggings Creek supported some 200 men for a period of 6 months and a smaller number for 5 years, but the find was never officially reported as payable.

Alluvial gold was discovered by Webb and party on the lower part of the valley in 1896, and at once reported to the Warden. A small "rush" resulted and, owing to the disappointing returns, one of the prospectors had a narrow escape from lynching by the angry miners. The total recorded return of alluvial from Munburra, the name given to this locality, is only 639 oz.

Although the alluvial rush here was a fiasco, it led within a remarkably short time to the discovery of most of the reefs now known on the field, the Last Hit being the first find of importance. A small

Photo., L.C.B.

FIG. 1.—THE VALLEY OF THE STARCKE, SHOWING ESCARPMENTS OF THE TRIAS-JURA PLATEAU.
(Looking over the Last Hit.)

battery was erected on the field in 1898, and a second in the following year. The miners quickly worked out the pay shoots above water level, and in 1902 the first pump was installed (on the Boomerang).

Owing to no reserves having been made it became evident as early as 1901 that little more could be done by the individual miner, and attempts were made to interest outside capitalists in the field. A small local company carried on operations on the Boomerang claim during 1901, and in the following year gave place to another, known as the Queen Alexandra. In 1907 the Starcke United Gold Mining Company was floated, and took over most of the western holdings. The capital of the first companies was too small, and the last has now had to cease operations, chiefly because of frequent changes of management and the expense of mining and treatment. The latest reports from the mine, which is the deepest on the field, are not as favourable as could be desired, but it does not appear to have been taken into consideration that the shaft is off the gold-bearing shoot, which should be picked up by driving along the reef.

At the end of 1908 there were 35 miners on the field.

TREATMENT.

In the early days of the field there were two batteries in the vicinity of Munburra, but for many years only one, Mr. Stuckey's, has been available (the other having been removed to the Hamilton Goldfield). That is of an extremely light and out of date type, with two pairs of stampers, each pair in a separate mortar box. The amount of stone crushed per shift of 8 hours is only 4¼ cwt. per stamp. The stampers weigh only 5 cwt., and have a 9-in. drop; and the boxes are hand fed. The silvered plates below the battery have a total length of 4½ ft. Beyond this there are no appliances for further treatment of the sands, and miners are of opinion that much of their gold goes into the tailings. This cannot be denied in view of the returns obtained from cyaniding during 1906 and 1907, more especially as the losses in the sands were still considerable.

In considering the value of the Munburra reefs this high loss is a matter of some importance, as it has been taken into account when deciding that certain stone could not be profitably treated. It is locally believed that there are large bodies of stone available, which would carry from ½ to 1 oz. gold per ton.

The price charged for crushing is 25s. per ton.

At the Cocoa Creek mines there is a 5-head iron-framed stamper battery with 16-h.p. engine and grinding pans—all in a ruined state. An old chlorination barrel shows that some experiments in treatment were carried out here.

OUTPUT OF THE FIELD.

The figures given below have been compiled from tables lent me by the Warden, Mr. Cherry, with additions made on the authority of Mr. Stuckey, the proprietor of the Starcke battery. They include the alluvial gold from the old diggings, the Munburra alluvial, the Munburra reef gold, and the alluvial and reef gold from Cocoa Creek. There is some doubt as to whether the whole of the 638½ oz. of gold placed as Munburra alluvial does not include gold dollied from the caps of reefs.

	Tons cwt.	Oz. dwt. gr.	Yield per ton. oz. dwt.	Value per oz. (1) £ s. d.	Total Value. £
		Old Starcke Alluvial.			
1890 ...	...	272 14 15	...	...	1,092
1891 ...	...	922 2 14	...	...	3,690
1892 ...	...	443 4 19	...	...	..
1893 ...	...	521 0 0	...	4 0 0	...
1894 ...	...	88 15 0	...	...	...
1895 ...	...	52 5 0	...	...	..
Total ...	...	2,300 4 0			
		Munburra Alluvial.			
1896 ...	...	364 9 12	...	...	...
1897 ...	...	274 0 0	...	4 0 0	...
Total ...	...	638 9 12			
		Munburra Reefs.			
1898 ...	189 15	1,246 15 11	6 11½	3 17 6	...
1899 ...	1,130 17	2,655 11 11	2 7	...	...
1900 ...	667 4	905 6 12	(2) 1 7	...	...
1901 ...	279 5	(2) 1,054 9 0	3 16	...	...
1902 ...	544 10	(2) 1,270 10 0	2 6½	...	..
1903 ...	313 15	(2) 557 10 18	1 15½	3 15 10	...
1904 ...	217 0	(2) 274 3 0	1 5	3 14 10	...
1905 ...	58 0	74 0 12	1 5½	3 16 6	283
1906	46 0	41 19 0	0 18	4 4 0	...
	795 0	(3) 214 5 0	0 5½	3 3 8	...
1907	69 10	(2) 125 0 0	1 16	...	...
	(4) 224 10	(3) 45 19 0	0 4	...	...
1908 ...	323 10	724 18 0	2 5	...	...
Total ...	4,858 16	9,190 7 16	1 18		
		Cocoa Creek.			
1892 ...	16 0	41 0 0	2 11	...	...
1893 ...	367 0	352 0 0	0 19	...	...
1894 ...	561 0	539 0 0	0 19	...	...
1895 ...	174 0	138 0 0	0 16	...	...
1896 ...	21 0	38 0 0	1 16	...	...
Total ...	1,139 0	1,108 0 0	0 19½	3 18 0	

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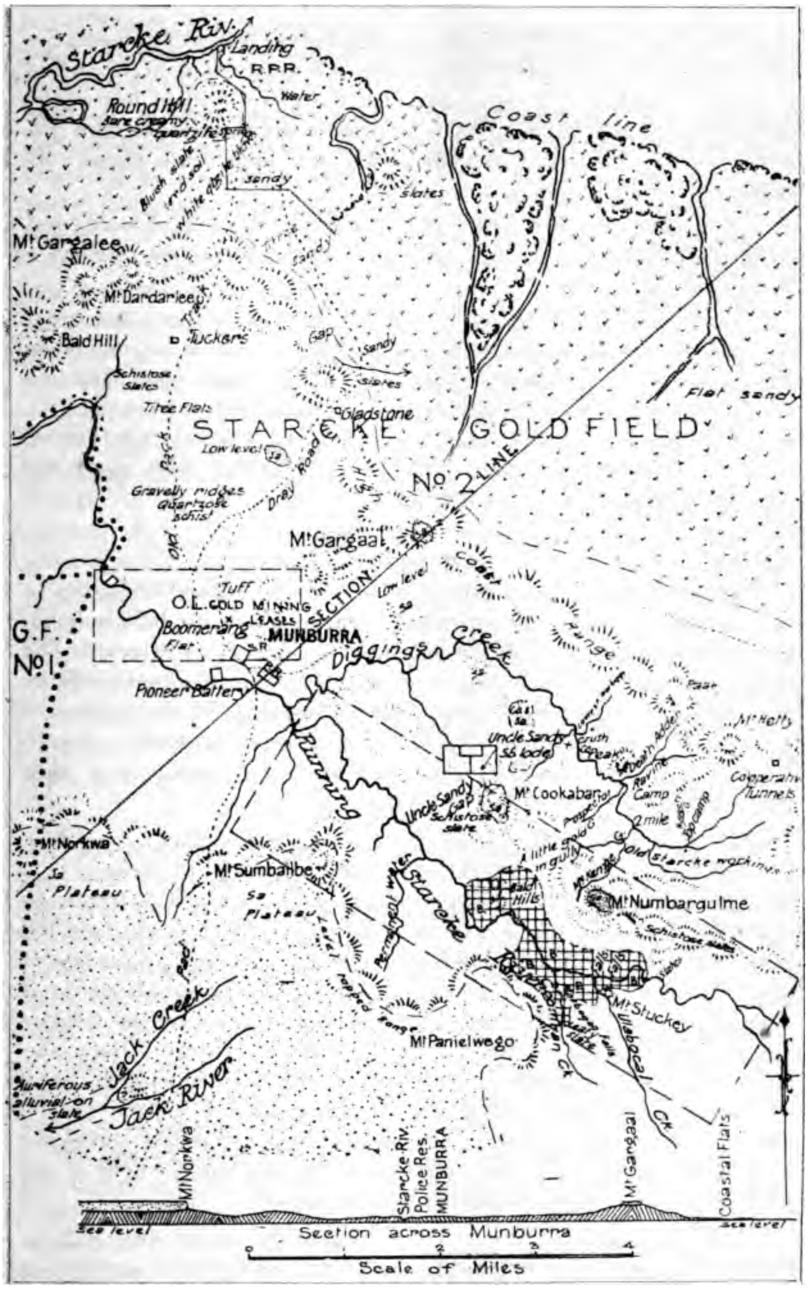
(1) The value of the Starcke has generally been placed at about £4 per oz., though in a great number of cases the miner actually received only £3 15s. to £3 17s. 6d. per oz. (2) Differs from Warden's report. (3) Cyanided. (4) *Queensland Government Mining Journal*, monthly reports.



MAP. 2.—GEOLOGICAL SKETCH PLAN OF PART OF THE STARCKE VALLEY.
Scale: 2 miles to an inch.

GEOLOGY.

The basal beds of the field are altered palæozoic sedimentaries which have been sharply folded, with the production of a certain amount of crushing. Interbedded with these are flows of leucophyre and beds of tuff, which appear to have some connection with the auriferous nature of the quartz deposited in fissures in the slates, subsequently to the folding.

Overlying the slates there is a moderate thickness of sandstone, conglomerate and shale, to which can with confidence be ascribed a Trias-Jura age.

The valley of the Starcke is similar to most of the other great depressions of erosion along the coastal escarpment, in having in its deepest part a small flow of basalt of quite recent age. Mention is made of other flows in my report on the Cooktown Coalfield (1), and it is there shown that they have probably a genetic relationship with the Cook uplift, during which the Trias-Jura beds along the coast were elevated more than 1,000 ft.

PALAEOZOIC.

Sedimentaries of undetermined age, but probably belonging to the palæozoic system and comprising shales, slates, sandstones, greywackes, tuffs, and leucophyres form the basement of the Starcke. The slates in places near reefs have been greatly silicified, presumably by the spreading out of the solutions that brought in the auriferous quartz. In other parts they exhibit an "augen structure" due to crushing, a continuance of which has sometimes produced a well-marked schistosity.

The tuff rock at the surface has the appearance of a very fine-grained micaceous grit, but at a moderate depth this changes to a dark blue siliceous and micaceous greywacke. Such a rock forms the country at the Last Hit and Queen Alexandra. That at the Last Hit is composed chiefly of angular fragments of quartz and plagioclase in a siliceous and chloritic base. The rock at the Queen Alexandra is neutral tinted, and rather more siliceous than the above, the felspars are slightly kaolinised, and a little pyrite is present. Here also occurs a rock provisionally regarded as tuff, its components being quartz, orthoclase and plagioclase set in secondary silica and calcite. The rock from Mount Hetty, on the old diggings, differs somewhat in that the base is more distinctly felspathic, the bluish colour of the rock being derived from finely divided chloritoid.

The working out in detail of the geology of the area will be greatly complicated by the occurrence of very fine-grained sandstones, which it is scacely possible to distinguish without microscopic examination from the micaceous tuffs.

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(1) *See* Q.G.M. Journal for April, 1909.

"*Dykes.*"

Undoubted igneous rock was collected at the Rapport shaft, on the Boomerang P.C., the Queen Alexandra, the Rio Tinto, the Lily of the Valley, the Gold Mount, and Butcher's. It varies only from a felsite to a quartz porphyry, and may therefore be considered as derived from one magma, and on account of its light colour may generally be referred to as leucophyre. In some places, as at Rapport's shaft, it is a devitrified felstone; at the Queen Alexandra the felspar and quartz occur as phenocrysts, and the base is sometimes spherulitic. Specimens obtained in the vicinity of the Mountain Maid and Gold Mount have suffered much replacement by secondary silica. On the whole the evidence afforded by a microscopic examination is in favour of a volcanic origin as against hyperbyssal, and the association of acidic tuffs points in the same direction. Nevertheless, the data obtained in the field, it must be admitted, are inconclusive, most of the specimens of undoubted igneous rock obtained having come from inaccessible shafts. On the accompanying map the leucophyre is shown in belts, but it cannot be asserted that the rock will be found continuously along these lines. In all probability the outcrops found are quite disconnected along the surface, though generally alligned as shown. Then again the rock has suffered such extensive weathering that it is often difficult to distinguish it in the field from accompanying micaceous tuffs and sandstone, which are generally classed as "porphyry" by the local miners.

Felsitic rock was also noticed at the western end of the First Call lode at Cocoa Creek, thus bringing the conditions on the two fields into agreement.

REEFS.

The Munburra reefs are located in the stumps of an ancient and now worn down mountain chain, and it might therefore be argued that they are also of great age, but that does not necessarily follow. It is nevertheless more than probable that the metalliferous solutions became active prior to the Cook uplift, elsewhere referred to. Such being the case, one would not expect to find quartz veins in the overlying Trias-Jura sandstones.

In all, some 26 reefs have yielded crushing stone. It has been stated that the reefs have a general east-west trend, and are connected with north-south dykes of porphyry, but this is to be taken in a very general sense, for though the mean trend may be east-west, the strikes vary from south-west to north-north-west. That the gold-bearing reefs have some connection with porphyry dykes is also undeniable, but the relationship of these dykes to the country is not at all plain. While most of the reefs have a strike diagonal to that of the dykes, there are exceptions, of which the best examples can be seen on the Starcke Consols lease, where quartz leaders run along either or both sides of the dyke.

The occurrence of gold is very patchy, and the shoots generally have the form of pipes pitching westwards. At the Last Hit (and possibly at the Boomerang and Queen Alexandra) the auriferous shoot is widening as depth is attained.

The reefs branch frequently or fray out; they are distinguished by much slickensiding; and they are of the class known as metasomatic or replacement fissure veins. Some of the fissures may, and probably do, have great length, though quartz has been deposited along them in comparatively short bunches. The fissuring has been followed in most cases by some movement, causing crushing of the wall rocks. Siliceous solutions have percolated along the resulting planes of weakness, from which they have sometimes spread out metasomatically replacing practically the whole of the intervening country rock.

A banded structure, brought about by parallel lines of dark-coloured chloritic mineral, is typical of the quartz on both the No. 1 and the No. 2 fields. Calcite occurs sometimes in thin sheets, and mispickel crystals are often plentiful in the crushed rock, but pyrite was observed less frequently.

All stages in the process of replacement can be observed, sometimes in a single hand specimen, and the vein thus sometimes has a pseudo-brecciated appearance, owing to included unreplaced fragments of country rock. This structure is shown in Fig. 2. Microscopic examination of a thin slice taken from this specimen, which is from the Hit or Miss reef, has resulted in the discovery that the quartz is accompanied by much plagioclase, as depicted in Fig. 3. This section

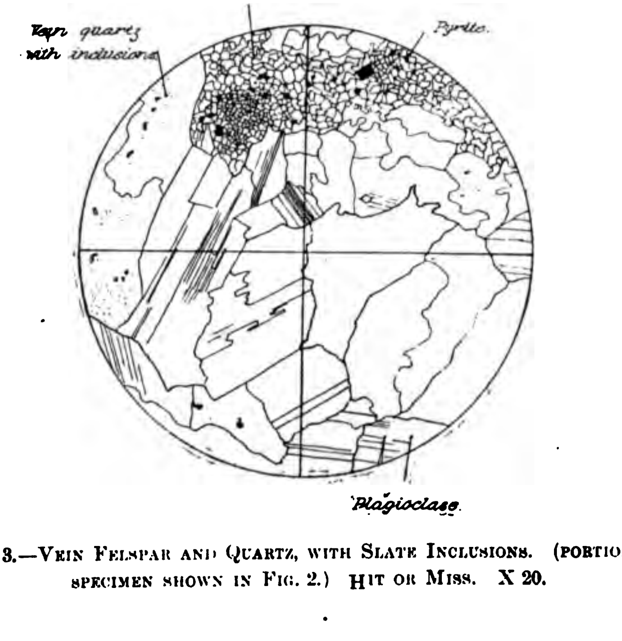
Secondary quartz (replaced country rock).
Vein quartz with inclusions
Pyrite.
Plagioclase.

FIG. 3.—VEIN FELSPAR AND QUARTZ, WITH SLATE INCLUSIONS. (PORTION OF SPECIMEN SHOWN IN FIG. 2.) HIT OR MISS. X 20.

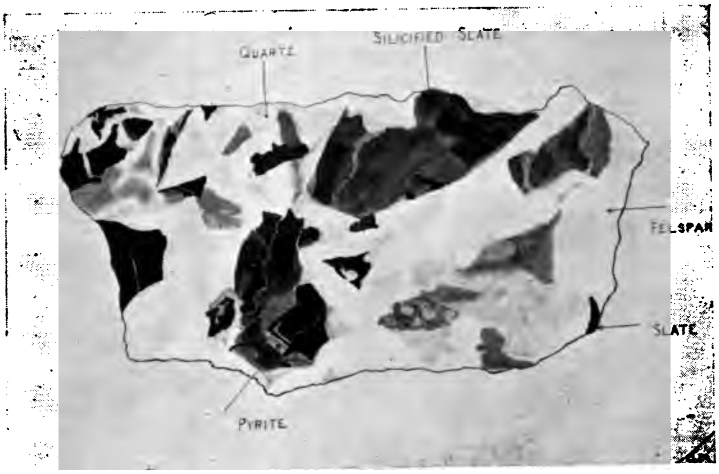

Fig. 2.—Gold-bearing Ore (slate in process of replacement by quartz and felspar). Hit or Miss. X 2.

shows that the included fragments of country have been replaced by a fine mosaic of secondary silica, while the coarser quartz and the felspar occupy the open spaces between those fragments. The discovery is of much interest, as having a distinct bearing on the origin of the vein quartz and gold of the whole field, for plagioclase was also detected in small quantities in rich ore from the 125-ft. level of the Last Hit. The only previous description known to me of felspar occurring in an Australian gold-bearing reef is that of Lindgren, (1) who found crystals of albite intergrown with quartz in small drusy cavities at the South New Moon Mine, Bendigo, Victoria. Albite had previously been discovered in the gold-quartz veins of California and Alaska, while orthoclase is abundantly developed in certain veins occurring in tertiary lavas—*e.g.*, in Idaho, Colorado (Cripple Creek), Nevada (Tonopah), and New Zealand (Waihi). From this Mr. Lindgren tentatively concludes that the kind of felspar is in some way dependent on the depth at which it was deposited, the orthoclase-bearing reefs having been formed much nearer the surface than the gold quartz veins of California, Alaska, Victoria, and, we may add, Queensland.

TRIAS-JURA.

The escarpments and table-tops of the Trias-Jura beds are the most prominent feature of the topography of the Starcke field. No fossil evidence as to their age was secured locally, but they can be traced without a break southwards to the railway line, where Trias-Jura fossils have been obtained. (2) Mr. Webb informed me that fragments of coal were obtained by him on the north branch of the Jack River, the first stream of importance south of the Starcke. On Mount Cookabar (the nearest mesa to the mines) the basal beds are conglomerate, above which there is ferruginous shale overlaid by sandstone.

Occasional small areas of sandstone were noticed in the Starcke Valley quite 1,000 ft. below the base of the plateau beds, and an attempt was made to account for them by trough faulting, but it seems much more likely that they are simply residual masses of the beds which formerly extended over the valley. One stretch, ½ mile long and 1 ch. wide, is crossed on the track 1½ miles east of Munburra. Some of the boulders have been hollowed out presumably by wind action following on crustal induration by atmospheric agencies.

BASALT.

A narrow flow of basalt occupies the bed of the Running Starcke River for about 3 miles above the Bald Hills, which are probably on the site of the orifice from which the lava flowed. The upper part of the flow is coarsely vesicular, while the central portions are incipiently columnar. This structure has resulted in the production of several falls in the river, the Ulabocal Falls being 25 ft. deep, and the Marbogan Falls 60 ft. This may be taken as the thickness of the flow at the latter place. The width of the flow would seem to have been never more than ½ mile. Microscope sections reveal the presence of much fayalite, with felspar laths and magnetite grains in a glassy base.

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(1) Economic Geology, Vol. I., p. 162.

(2) See Geological Reconnaissance of the Cooktown Goldfield. Q.G.M. Journal for April, 1909.

AURIFEROUS ALLUVIAL DEPOSITS.

The auriferous alluvial deposits of the Starcke fields are unfortunately of exceedingly limited extent, comprising as they do only the modern wash in the beds of creeks, gullies, and ravines. In all cases, except the Jack, the gold is connected with the occurrence of felsite or leucophyre.

Old Starcke.

The Old Starcke alluvial workings are at the head of Diggings Creek in about the centre of the No. 2 goldfield, and 4 miles east of Munburra. Gold was discovered here in 1890, and some 200 men were employed gully-raking for a period of six months. Nuggety, McKenzie's and Prospectors' Gullies were the most productive. Several other ravines, including Bearaway and Fearaway, yielded coarse gold, nuggets of 37, 32, 27, 25, 15, and 10 oz. having been reported from the latter, and one nugget of 14 oz. was found in the first-mentioned.

Death-adder Gully was noted for the coarseness of its gold, but the patches were too far apart for profitable work. A little gold was also got all along the main creek bed, the best return being from just below the Top Camp.

Output (*See* Output of the Field):

1890 to 1895—2,300 oz. 4 dwt. gold, worth £4 per oz.

Munburra.

Gold was discovered in Kitty Gully by Webb and party when on a prospecting expedition subsidised by the Government. The gully proved auriferous for a distance of only 3 or 4 ch., and it is said that not more than 50 oz. of gold could have been taken from the bed, the section of the ravine being V-shaped, as flats had not yet been formed.

Several other adjacent gullies were afterwards raked for small returns, the gold in all cases being found below crops of tuff or leucophyre; and that from Starlight Gully was the coarsest recorded. The flats below the Boomerang reefs are promising, but are stated to have been tested for very poor returns. Antimony Creek, which comes down from the Uncle Sandy Mine, was also payably auriferous for a short distance on the flats.

Output (*See* under Output of the Field):

1896 and 1897—638 oz. 9½ dwt. gold, worth £4 per oz.

Jack River.

A little coarse gold has been found in alluvium on the Jack River in the south-western corner of the No. 2 field, about 8 miles south of Munburra. The country is stated to be slate capped on the ridges by sandstone and conglomerate. The find was of little importance, not more than 20 oz. being secured. An interesting discovery, that of a 4-gr. speck of gold in the conglomerate, was reported by Mr. J. W. Webb; but all further testing of the same rock by dollying failed to locate another "colour." Mr. Webb states that the gold was enclosed in a quartz pebble, indicating that the reefs are older than Trias-Jura.

This small patch is of much interest, as it indicates the general auriferous nature of the whole area between the Cocoa Creek and Munburra workings, unfortunately now covered in great part by thick beds of barren arenaceous sedimentaries.

Cocoa Creek.

Most of the alluvial workings, the deepest of which was 11 ft., are on the northern slope of the low ridge between Cocoa and Yamba Creeks, heads of the McIvor River, and in the south-eastern corner of the Starcke No. 1 Goldfield.

The old surface workings extend over a width of ½ ch., for 5 ch., beginning 5 ch. north of the gold-antimony lode, elsewhere referred to, with which they have no apparent connection.

The country rock is indurated quartz-veined slate, from leaders in which the gold would seem to have been shed. Much "specimen gold," *i.e.*, gold attached to quartz, was found in the soil here, and from one claim was collected 12 tons of rubble, which yielded 4 oz. gold per ton. The gold here, as on the No. 2 field, was worth £4 per oz.

The short gullies running southwards into Cocoa Creek from the antimony lode have also been raked for gold.

There seems to have been no record kept of the amount of gold obtained in these old workings.

HOLDINGS.

At the end of 1908, there were in force only four leases: G.M.Ls. 17, 21, 24, and 25, and two claims: M.Cs. 117 and 118. The most unfavourable sign was the absence of any registered prospecting areas. The only mining going on at the time of my visit was on the Last Hit and the Rio Tinto.

The Starcke United G.M. Co., Ltd., is the registered holder of Gold Mining Leases 17 (the Last Hit, 5 ac. in area), 21 (the Starcke King, 22 ac. in area), and 24 (the Starcke Boomerang, 3½ ac. in area).

For purposes of description the reefs will be taken in alphabetical order, and where possible under the name of the original proprietor. This will cause no trouble, as the reefs seldom crop beyond the one claim or lease.

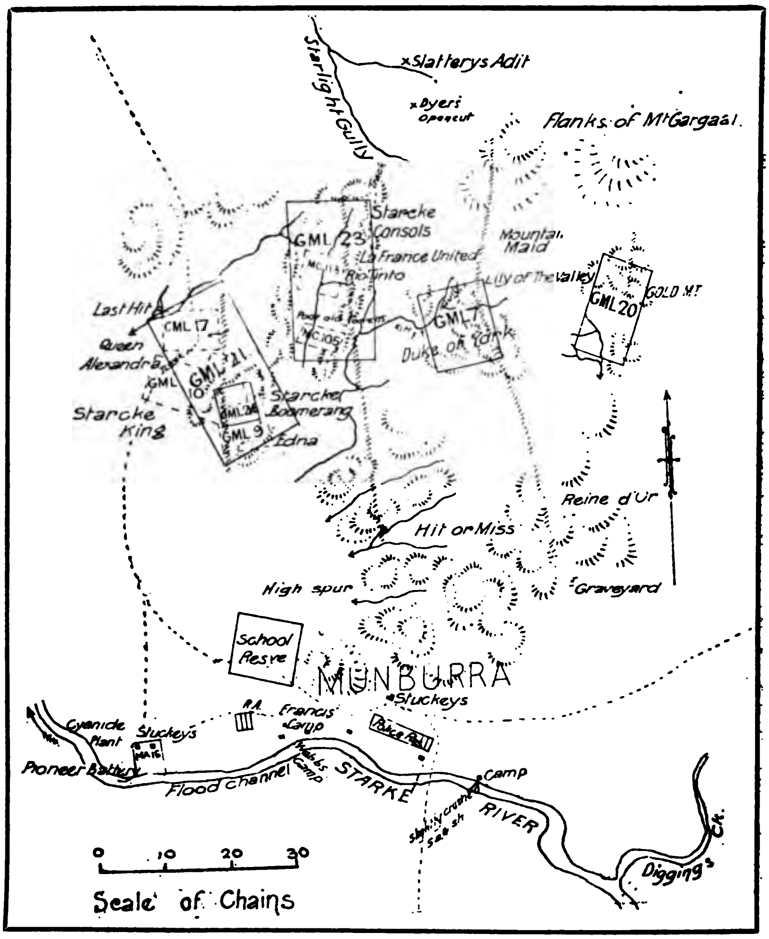

FIG. 4.—PLAN OF STARCKE LEASES, SHOWING LEUCOPHYRE AND TUFF BELTS.

Boomerang P.C.

This claim is now included within M.L. 24, which lies a little over ½ mile north-north-west of the Munburra police reserve, and is held by the Starcke United Company. Three distinct lines of reef were worked on it, the quartz being most highly auriferous where milky, and especially where black laminæ are numerous.

The main line, dipping about 80° northwards, runs east-south-east from the western side of the lease for 1 ch., and then suddenly bends to the east-north-east, and frays out within a chain. The vertical whip and underlie pump shaft on this are said to be 90 ft. in depth, but no means had been provided by the manager for making a descent. The underlie shaft is said to have struck the reef at 72 ft. below the surface, and to have been continued on the underlie, with considerable difficulty owing to the heavy water met, necessitating first the erection of a horse-whim and later the installation of a steam pump.

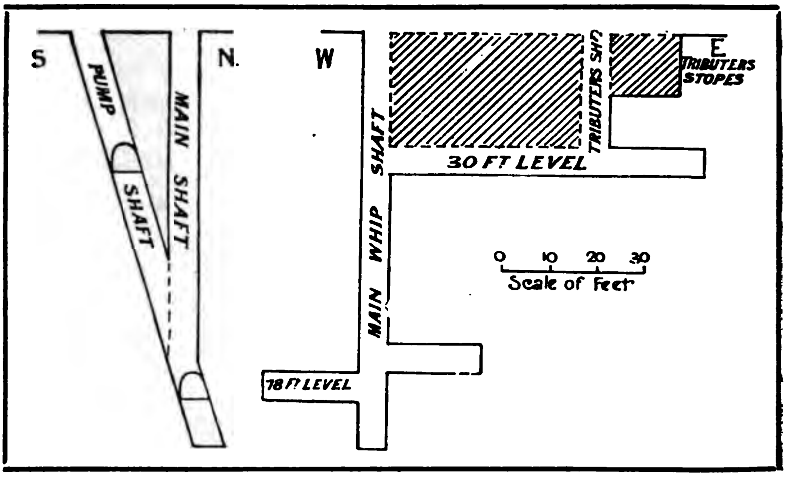

FIG. 5.—THE MAIN BOOMERANG WORKINGS.
By Lionel C. Ball, B.E.

It is understood that drives were carried 20 ft. both east and west at the 78-ft. level, and for 65 ft. east at the 30-ft. level; and that the reef has been stoped out above the latter level for 30 ft. from the shaft. Rich stone is said to have been taken out at the 55-ft. level.

The tributers' shaft, at the eastern end of the stope above the 30-ft. level, was sunk by a party of men, while waiting to begin work on the Last Hit. A small block of the reef about 15 ft. square was broken down by them and 5 tons of the ore (bluish glassy quartz, with laminations and inclusions of country rock) is still stacked at the surface. A surface sample of this has been assayed as below (Government Analyst):

Gold	12 dwt. 19 gr. per ton.
Silver	2 dwt. ,,

A parallel leader to that worked by the tributers, about 20 ft. to the south-south-east, has been sunk on, but the shaft is too old to allow of an examination.

A second line of reef, striking east 10° south and dipping 80° northwards, lies 40 ft. north of the main line at the vertical shaft, and seems to run from the No. 1 W. shaft. A shaft sunk to 50 ft. below the surface is now half full of water, but the reef can be seen in the upper part to be about 6 in. wide and fairly uniform in width, though there is a slight pinch at 20 ft. depth, and blocks up to 12 in. across have been raised. The quartz is crystalline, and contains inclusions of country but, though there were good prospects on the surface, little gold was got below. The foot-wall country is a dark micaceous sandstone, striking north-north-west, but the hanging-wall is porphyry, and in this are the inclusions.

At 40 ft. west of this shaft there is another, 30 ft. deep, but fallen in, and here also quartz-felspar-porphyry is showing. The belt of porphyry would, in fact, seem to run westwards here to the boundary of the P.C. when it bends to the south again.

A little gold-bearing stone was taken from a trench within the P.C., on the line of the No. 1 E. workings, but quite 1½ ch. from them.

In the northern part of the claim there is an old shaft on an east-west leader, from which a bunch of pay quartz was taken. The shaft is in porphyry.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
July, 1898	...		crushed for	250	0	0 (1)
August, 1898	6	10 (2) (3)	,,	38	0	0
April, 1899...	15	10 (3)	,,	47	10	0
July, 1899	3	0 (3)	,,	26	3	0
September, 1899	1	10	,,	1	2	12
,, ...	4	0 (4)	,,	1	10	0
October, 1899	7	0 (5)	,,	2	2	12
,, ...	3	0 (6)	,,	121	12	0
,, ...	40	0 (5)	,,	5	0	0
December, 1899	29	0	,,	52	6	0
,, ...	1	10 (6)	,,	54	0	0
May, 1900	11	0 (7)	,,	24	0	0
May, 1901	5	0 (8)	,,	101	0	0
September, 1901	10	0 (8)	,,	95	0	0
February, 1902	8	0 (9)	,,	90	0	0
April, 1902...	13	0 (10)	,,	89	0	0
November, 1902	23	0 (10)	,,	87	0	0
February, 1903	9	5 (10) (11)	,,	14	10	0
Total	190	5	,,	1,099	16	0

(1) Estimate of dollyings by Mr. Webb. (2) Seconds from dollyings (4 or 5 cwt. yielding 1 to 3 oz. to dish). (3) Pump shaft. (4) Seconds. (5) Surface floaters on flat below main shaft. (6) 55 feet depth in pump shaft. (7) Surface holes, mixed country. (8) Cooktown Boomerang Gold Mining Company, from main shaft. (9) Raised by prospectors. (10) Queen Alexandra Company. (11) Bottom of main whip shaft.

Boomerang No. 1 W.

A little work was done on the western part of the main P.C. reef, but the chief operations were carried out on the southern end of the Ruby United line. The reef underlies 45° to the south-west

One shaft to the west of the Boomerang workings is 60 ft. deep, and from it stopes, now fallen in, extend for 50 ft. to the south-east. These reach from the surface to the 30-ft. level. At the 60-ft. level there is a drive for 40 ft. to the south-east, and from it a winze has been sunk a few feet.

The reef has been followed and trenched or sunk on to shallow depth for 2 ch. to the south-east of the shaft and for 5 ch. to the north-west-by-north over a steep ridge, where are the Ruby United workings.

Output (1):

	Tons	cwt.		Oz.	dwt.	gr.
November, 1898	17	0	crushed for	59	2	6
September, 1899	22	0	,,	87	14	0
January, 1900	9	12	,,	15	10	0
May, 1900	11	0 (2)	,,	19	0	0
Total	59	12	,,	181	6	6

(1) Gorton and Fitzgerald. (2) Porphyry shaft on main Boomerang line.

Boomerang No. 2 W.

A shaft has been sunk 15 ft. on a north-west striking leader on the claim, which is on the western side of the Starcke King. A number of trenches have been opened, but proved that there was only one small bunch of payable ore here.

Output:

June, 1899—4 tons crushed for 7 oz. 13 dwt.

Boomerang No. 1 E.

It was formerly considered that the eastern numbers of the Boomerang were on the same line as the P.C., but my map shows that they are on a parallel line, lying quite 2 ch. north of the line of strike of the reef worked by the P.C. tributers. The fact that the pump on the P.C. line had no effect on the level of the water in the eastern workings conclusively proved the absence of any connection.

The reef strikes north-east-by-east and underlies 45° to the north-westwards. It was probably small but very rich.

The old workings, which comprise two vertical and two underlie shafts, are now quite inaccessible, and very little can be learnt as to the nature of the reef or the extent of the workings. The easternmost underlie is known as Dyer's whip shaft, and, to judge from the size of the tip, much driving must have been done here, in sandy shale and slate country and pyritous formation. A 5-oz. leader was stoped in

Mr. Rands reported (¹) in some detail on the claims in force at Cocoa Creek in 1893.

In 1900 a lease of 5 ac., known as the First Call, was secured, but no work appears to have been carried out until 1906, when an English firm was induced to take an option over the property with a view to proving the reported existence of large deposits of antimony ore. The disappointing results obtained led to the speedy closing down of the mine, and towards the end of 1908 the winding gear was removed to the Starcke Consols.

Six shafts have been sunk to various depths over a distance of 10 ch. The main or No. 2, and the No. 1 shafts, which are both 150 ft. in depth, are connected by a drive at the bottom, above which the ore has been stoped out. After having been unused for several years the English firm cleaned out the No. 2 and reopened the bottom drive. About 5 ch. to the east-south-east there are two old shafts 70 and 30 ft. in depth, only 1 ch. apart but not connected. Going westwards there is an old shaft 2 ch. from No. 1 and 20 ft. above it; and 1 ch. beyond it is an open-cut on the ridge top. Another 70 ft. shaft lies 3 ch. south of the main shaft.

The chief lode strikes about east 30° south, underlying southwards at an angle of 85°. A second lode, said to run due west from the eastern shaft, has been sunk on to a depth of 70 ft. in one place.

Nothing can now be seen of the crops, but it is understood that the main reef averaged about a foot in thickness, with bunches quite 4 ft. across. Residual lumps of oxidised antimony ore were found in the surface workings, and these carried from 3 to 5 oz. of gold per ton. At a shallow depth stibnite was met, chiefly in the central portion of the quartz reef, but from the sulphide ore not more than 1 to 2 oz. per ton could be extracted. As sinking continued the percentage of antimony perceptibly decreased, and with it the gold, and it is said that the optionists were able to secure only 2 tons of 50 % ore at the 150-ft. level—such a disappointing quantity that work at once ceased.

The quartz on the tip at the No. 2 shaft is laminated, and contains inclusions of bluish crushed country rock, and generally resembles that of the Munburra reefs. The associated stibnite makes the resemblance to the Uncle Sandy ore complete—though the mines are 17 miles apart.

The surface rocks at the main workings are a light-coloured gravel-forming schist and slate, striking north and south, but from the lower workings much bluish, partly crushed, speckled tuff has been raised. The crushed rock contains sporadic crystals of pyrite, and most likely comes from a formation adjacent to the reef.

(¹) Geological Observations in the Cooktown District, by William H. Rands, Assistant Government Geologist. Bris.: By Auth., 1893.

The eastern workings yielded some 2-oz. stone, but this portion of the reef was very poor in antimony.

The western open-cut is on the western side of a north-south crop of quartz-veined felsite, and the occurrence is very similar to that at the Gold Mount, 18 miles to the north. A local tradition has it that a trial crushing from here yielded 5 dwt. per ton.

Output (²):

	Tons.		Oz.
1892	16	crushed for	41
1893	367	,,	352
1894	561	,,	539
1895	174	,,	138
1896	21	,,	38
Total	1,139	,,	1,108 (³)

(²) Annual Reports of Department of Mines.

(³) Average value, £3 18s. per oz.

Duff's.

Duff's shaft is at the head of the Boomerang ravine, between the Starcke King and Starcke Consols leases. It was 30 ft. deep, but has caved-in, and the leader cannot be seen.

Output:

August, 1901—2 tons crushed for 1 oz. 11 dwt.

Duke of York.

The Duke of York (G.M.L. No. 7), now forfeited, lies ¾ mile north-by-east from the police reserve. A Maryborough-Gympie Syndicate had two men working here for a time, and towards the end of the year a claim (M.C. No. 118) was applied for, but, there being no one on the ground, it was not located by me.

The Duke of York workings are in proximity to a dyke of porphyry that can be traced from beyond the Mountain Maid on the north to Butcher's on the south. The northernmost comprise potholes on a shoot that has given good returns outside the lease. Half way down the lease there are a shaft, 25 ft. deep, and an adit, 30 ft. long, above which a stope extends for 10 ft. Then in the south-eastern corner there are several old shafts on a reef less than 10 in. thick.

Surface stone from several shoots along the line is said to have been dollied with good results. The reef in the shaft is believed to be about 8 in. wide, but there is on the tip much dark blue, quartz-veined, pyritous formation (crushed rock) as well.

Output (¹):

	Oz.	dwt.
1898—Dollied by Mr. Webb	20	0
October, 1901—3 tons crushed for	8	2
Total	28	2

(¹) It is understood that a quantity of stone from this mine was crushed with some from the Hit or Miss.

40-ft. level east and below the 75-ft. level west have been stoped out, besides which a little stoping has been done between the top adit and the 40-ft. level west, and between the 40-ft. and 75-ft. levels east.

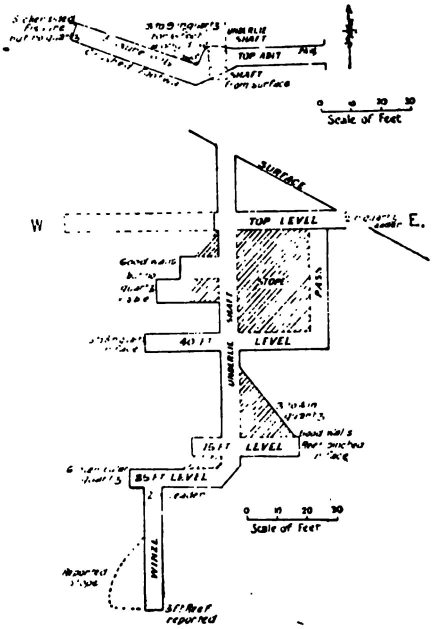

FIG. 7.--THE GLADSTONE WORKINGS.

In spite of the comparatively large output very little can be seen of the reef in these workings. At the mouth of the top adit there is a ½-in. quartz leader, and the adjacent tuffaceous country is strongly iron-stained over a width of 8 or 10 ft.; and just beyond the underlie shaft a reef, 3 to 9 in. thick, extends for 6 ft., but beyond that there is only a strongly slickensided fissure. In the face of the 40-ft. level west there is 5 to 8 in. iron-stained crystalline quartz. Above the 75-ft. level 3 to 4 in. of quartz has been left in the stope, but the reef pinches out completely in the face of the eastern drive. On the 85-ft. level there is 6 in. of quartz in the western end, but only 2 in. above the winze, in which it is said 3 ft. of quartz was worked. (This, unfortunately, could not be examined, owing to the state of the ladder below the 85-ft. level.)

There would appear to have been a shoot of payable stone, 50 ft. in greatest length, between the top adit and the 40-ft. level. This pitches steeply to the westward and contracts in depth. The reef is very variable in size, but is typically lenticular in cross section.

Output:

	Tons	cwt.		oz.	dwt.	gr.
1898	...		crushed for	18	0	0 (1)
July, 1899	20	0	,,	59	15	0
March, 1900	118	0	,,	165	0	0
November, 1900	44	0	,,	31	0	0
September, 1901	30	0	,,	34	10	0
August, 1902	17	0	,,	11	12	0
November, 1902	21	0	,,	74	10	0
October, 1903	14	0 (2) (3)	,,	6	4	0
June, 1904	10	10	,,	22	0	0
,, 1904	7	0 (4)	,,	2	10	0
,, 1904	5	0 (5)	,,	5	10	0
November, 1904	29	10	,,	75	0	0
December, 1904	6	0 (4)	,,	3	12	0
August, 1905	46	10 (6)	,,	50	18	12
May, 1906	9	0 (7)	,,	3	3	0
Total	377	10	,,	563	4	12

(1) Mr. Webb's estimate of his dollyings from the first 12 ft. of sinking. (2) Headings. (3) *Fide* Mr. Stuckey, not given by Warden. (4) Seconds. (5) Trial crushing. (6) Not given by Warden. (7) Stone thrown on tip.

Gold Mount.

This forfeited lease (G.M.L. No. 20) is on a high spur, $\frac{7}{8}$ mile north-north-east of the police reserve.

In the northern part of the lease there are four separate shallow open-cuts on an outcrop of felsite. Gold was found on the surface over a width of 25 ft., chiefly in quartz fragments, and the first work done consisted of sluicing the soil during rainy weather. Quartz leaders were then found ramifying through the felsite, and an attempt was made to exploit the whole deposit, sending the stone down to the battery on pack horses. It was, however, proved that this could not be profitably done, and a proposal was made to erect an aerial ropeway to connect with a tramline at the bottom of the hill, but presumably sufficient work had not been done on the deposit to warrant the expenditure involved.

The occurrence of gold-bearing veins in felsite has been noted at Kilkivan (1) (in Queensland) and at Pambula (2) (in New South Wales).

Output:

May, 1906—2 tons crushed for 2 oz. 8 dwt. (3).

Graveyard.

The Graveyard claim is within $\frac{1}{2}$ mile of the police reserve, on the north-east.

Two shallow underlie shafts have been sunk on the line of strike, and a vertical shaft was put down in the hanging-wall country to a depth of 50 ft.

The country rock is a blue, chloritic, augen-schist, dipping 80° to the west-north-west. The rock here has in fact suffered far greater crushing than anywhere else on the field.

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(1) G.S.Q. Publication No. 28. (2) Mineral Resources of N.S.W., p. 63.
(3) *Fide* Mr. Stuckey. Not given by Warden.

The reef, which strikes east and west and dips 80° to the north, is very bunchy in form, varying from nothing to 7 or 8 in. in width, and is also irregular in value. As a whole the stone is said to be very poor, but lumps of quartz are found which run 10 oz. per ton. The quartz at grass is white, and banded with wavy lines of a bluish chloritic material, as at the Boomerang; and a little finely pulverulent, crystallised pyrite is to be seen in drusy cavities in it. The shoot of stone has not been proved over a greater length than 20 ft.

Output:

2 tons crushed for a yield of 2 oz. (1).

(1) *Fide* Mr. Webb.

Hamesly and Quinn.

This reef lies about ⅞ mile north-north-west of the police reserve, in the triangle between the Starcke United and Starcke Consols leases.

Two shafts 20 ft. apart have been sunk 50 ft., and some trenching has been done ½ ch. to the east.

A vertical reef has been stoped out between the shafts, but only shaly slate country is now exposed.

Output:

November, 1898—3 tons crushed for 5 oz. 6 dwt.

Hit or Miss.

The Hit or Miss (P.A. No. 55) lies in a gully, ⅜ mile north of the police reserve.

Two shallow shafts have been sunk on an east and west line, and a cutting has followed the leader westwards and round a bend to the south for 30 ft.

The country is fine-grained quartzite, sandstone, micaceous slate, and white quartz-porphyry, the last being in the main shaft.

Output:

	Tons	cwt.		Oz.	dwt.
September, 1899	2	0	crushed for	5	1
November, 1899	2	10	,,	3	9
September, 1904	6	0 (1)	,,	3	3
December, 1904	10	0 (2)	,,	11	18
August, 1905	6	10 (3)	,,	11	0
August, 1906	13	0	,,	7	19
Total	40	0	,,	42	10

(1) Warden gives "sundries." (2) Jephson and Co. (3) Frenchy. *Fide* Mr. Stuckey.

La France.

The La France workings, comprising an adit, open-cut, and shaft, are on the southern part of the Rio Tinto shoot, which is now included in the Starcke Consols lease (q.v.). The adit, 12 ft. in from the surface, meets Albert's underlie shaft, which is 60 ft. deep, and connects with the Rio Tinto adit, above which the ground is in an insecure state.

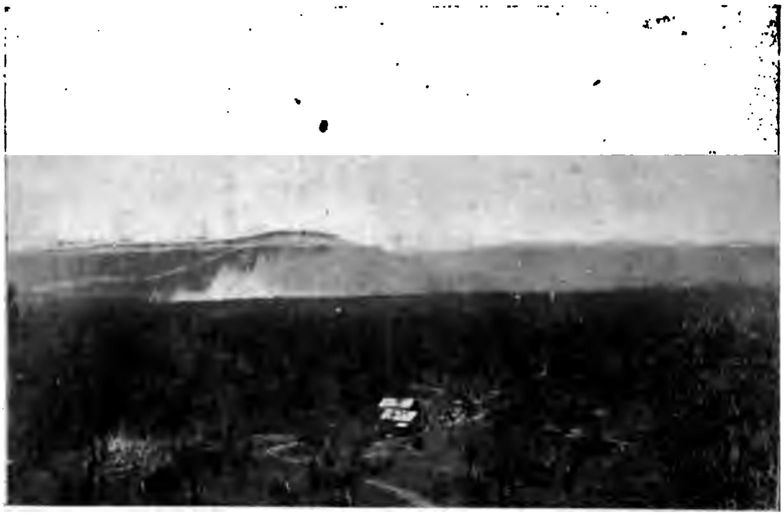

Photo., L.C.B.

FIG. 8.—THE LAST HIT NO. 1 SHAFT, AND THE TRIAS-JURA ESCARPMENTS OVERLOOKING THE VALLEY OF THE STARCKE.

There is at grass about 1 cwt. of laminated quartz carrying fine gold.

Output: *See* Rio Tinto.

Last Hit P.C.

The whole of this claim is now included within G.M.L. No. 17, which is itself surrounded by G.M.L. No. 21, and is held by the Starcke United G.M. Co.

There are four shafts: No. 1, now the main engine shaft, is 146 ft. deep; No. 2, the air shaft, is 65 ft. deep and lies 65 ft. east of the first. No. 3 shaft, 5 ch. to the east-south-east of No. 2, is 80 ft. deep; an air shaft is 20 ft. west-north-west of the last; and a duffer shaft lies 2½ ch. west-north-west of No. 3. A descent was made into Nos. 1 and 3, though no work had been carried out in the latter for a considerable period. In the former, however, sinking operations were going on, and a close examination of the whole of the workings connected with the shaft was possible.

At the main shaft is a steam winding engine of 12-h.p., which with 100 gall. buckets formerly kept the mine baled. Latterly, however, a Knowles sinking pump had been in service, and was often kept at its full capacity—3,800 gall. per hour. The water is quite potable, and must therefore be surface drainage. It is in fact believed by the miners to have been drawn from the old Boomerang workings, *viâ* the Ruby United.

The manager informed me that it cost 29s. per ton to mine, raise, and deliver the stone from the Last Hit at Stuckey's Battery. He also stated that the tailings from that battery were worth 16½ dwt. per ton, wherefore, to defray costs (including crushing) and to allow for losses, the stone mined should contain at least 30 dwt. per ton.

The east-west arm of the Last Hit lode, on which is the No. 1 shaft, has a proved extent along the surface of only 3 ch., but one of its branches runs for 3 ch. through the Nos. 1 and 2 W. claims. The No. 3 shaft is on a west-north-west striking reef, which has been followed for 1 ch. towards the No. 1 shaft and for 3½ ch. in the opposite direction. A split occurs in this reef, and a short branch runs out eastward from No. 3 shaft to the deep shaft on No. 1 E. claim.

The coarsest gold from the No. 1 shaft is dark yellow in colour and ragged in texture, and it occurs in laminated quartz containing inclusions of the country rock. Its occurrence is very patchy, much of the stone being barren but giving way quite suddenly to bunches carrying 10 oz. per ton. The stone crushed during the last two years has yielded between 2 and 4 oz. per ton, and considerable care had to be exercised to bring about uniform returns. The stone last crushed comprised dark blue graphitic slate, veined, especially where crushed, with quartz and calcite, the last mineral and the crushed rock containing a little pyrite. Minute crystals of mispickel—elongated prisms, terminated by brachydomes—sometimes in cruciform twins, were also noticed in the crushed rock.

The country rock, at a depth, is bluish tuff, veined with quartz and seamed with thin sheets of calcite.

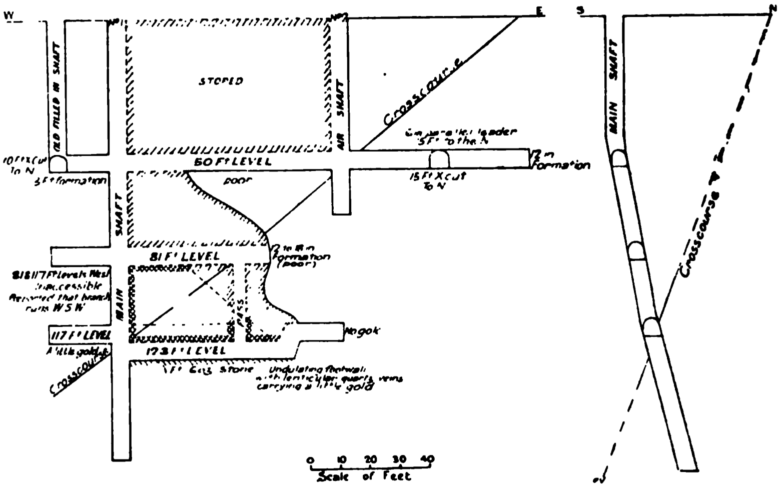

FIG. 9.—SECTIONS ON THE MAIN WORKINGS, LAST HIT.

No. 1 Shaft.—The shaft within the timbers is 3 ft. 3 in. by 9 ft. 9 in. in the vertical part and 3 ft. 6 in. by 8 ft. in the underlie. It is vertical for 40 ft., and then underlies 80° till towards the bottom, where it flattens to 75°.

In the bottom, 140 ft. below the surface, is the "reef," consisting of 8 to 10 in. auriferous quartz-veined formation without defined walls. A parallel formation, 18 in. wide and carrying colours of gold, lies 4 ft. back in the foot-wall. There has been a marked decrease lately in the gold content of the stone raised while sinking, but it was still mixed with stone from the 123-ft. level, this presumably accounting for the low yield in the last crushing. A cross-course dipping 70° to the north-west crosses the shaft at the 123-ft. level, dislocating the reef 3 ft. to the north-east. The cross-course is a water-bearing reef, 4 ft. wide, with well-defined and slickensided walls. It is believed to be poor in gold, but has not been sufficiently tested, although a 2-oz. parcel of stone was broken down from the main reef in its vicinity.

On the 50-ft. level west there is 3 ft. width of formation, but at the eastern end there is only 12 in. width. A parallel leader 6 in. thick was found in the crosscut north; this carried a little gold, but frayed out eastwards within 5 ft.

At the 81-ft. level a shoot of 2-oz. stone, 10 in. in thickness, was struck and worked out. In the eastern face 12 to 18 in. of slickensided, auriferous, quartz-bearing formation can be seen alongside 6 to 18 in. formation, but values are said to be low. The western drive is inaccessible; in it the reef splits, a branch running off to the west-south-west, as on the 117-ft. level west, which is also inaccessible.

Only the last 20 ft. of the 117-ft. level east was accessible; the reef was auriferous to within 5 ft. of the face, where the formation pinched to a foot in thickness and the quartz failed. Quartz is, however, appearing again in the face, and the walls, which are of promising dark-coloured rock, seem to be widening out. It was therefore proposed to continue driving with the idea of ultimately connecting with No. 3 shaft. The reef was 15 in. wide at the shaft, and three heaps of formation at the surface came from this drive. A surface sample was taken from the largest of these, and yields only traces of gold and silver (Government Analyst).

The 123-ft. level is really an underhand stope beneath the 117-ft. drive east. This is on the shoot first struck on the 81-ft. level, which has increased in length here to 56 ft. The formation averages 2 ft. in thickness, and of this 6 to 18 in. is quartz, which the manager affirmed would run 5 or 6 oz. per ton, it being certainly rich in visible gold. At the eastern end of the shoot the included country increases in quantity, and at the same time the gold contents rapidly fall. The full width of quartz-veined formation here is 5 ft., including a 3-in. vein of quartz 18 in. from the foot-wall. The foot-wall is undulating and well defined, but there are lenticular quartz veins carrying a little gold beyond it. The hanging-wall exhibits slickensides pitching steeply towards the east.

No. 2 shaft is now in use as an exhaust for the steam pump, and could therefore not be examined.

The stone from the surface at the No. 3 shaft was dollied in the earlier days of the field by the aid of blackfellows. Some of it carried 100 oz. per ton. This was presumably taken from the cut running for 20 ft. west from the shaft. An examination was made of the 80-ft. level. In the eastern drive, which is 60 ft. long, there is 6 to 12 in. of a soft bluish formation with good walls and occasional bunches of quartz, up to 6 in. across. A stope extends for 8 ft. from the shaft. The western drive, at 35 ft. from the shaft, following the hanging-wall makes a sharp bend to the north-west, its total length being 45 ft. The footwall appears to have been left, so that the drive really becomes a crosscut, and proves a thickness of 10 ft. of formation (quartz-veined pyritous country). Old miners speak of only 6 in. in the centre of the formation having been taken away for crushing. About 20 tons of the formation is stacked at grass, and a surface sample from it has been assayed (Government Analyst):

Gold	8 dwt. per ton.
Silver	2 dwt. per ton.

A stope extends westwards from the shaft for 12 ft., and at the end of it there is 4 ft. width of quartz, with including country, reported to carry 5 dwt. per ton. Mr. Webb, one of the former proprietors, informed me that during sinking the best gold was found at the intersection with three slightly auriferous leaders, which came out of the footwall.

There would seem to be a considerable body of low-grade formation in these workings, which should have been thoroughly sampled by the company, before operations ceased.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
July, 1898	4	5 (1)	crushed for	332	0	0 (2)
August, 1898	15	6 (3)	,,	246	11	0
October, 1898	20	0	,,	204	13	0
November, 1898	20	0	,,	117	12	0
December, 1898	20	0	,,	70	18	6
January, 1899	22	10	,,	25	0	0
February, 1899	35	10	,,	82	4	0
April, 1899	49	10	,,	443	0	0
May, 1899	38	0	,,	232	0	0
July, 1899	4	10	,,	6	10	0
August, 1899	57	0	,,	223	14	0
September, 1899	22	10	,,	40	14	0
December, 1899	106	0 (4)	,,	74	0	0
,,	50	10	,,	202	0	0
May, 1900	72	0	,,	342	0	0
December, 1900	73	0	,,	97	0	0
February, 1901	10	0	,,	6	10	0
August, 1901	50	0	,,	105	17	0
December, 1901	25	10	,,	97	10	0
May, 1902	35	0 (5) (6)	,,	13	0	0
,,	31	0	,,	56	0	0
,,	20	0 (5)	,,	7	17	0
June, 1902	9	0 (7) (8)	,,	4	17	0
July, 1902	12	0	,,	28	10	0
August, 1902	18	0	,,	64	3	0
September, 1902	32	0	,,	13	10	0
,,	36	0 (7) (9)	,,	5	15	0
October, 1902	30	0 (10)	,,	9	8	0
November, 1902	27	10 (11)	,,	75	10	0
December, 1902	59	0 (10)	,,	14	3	0
May, 1903	22	0	,,	32	0	0
,,	12	0 (12)	,,	4	0	0
June, 1904	21	0	,,	52	0	0
November, 1904	10	0	,,	14	14	0
December, 1904	6	0 (6)	,,	2	8	0
November, 1907 (13)	23	0	,,	53	0	0 (14)
March, 1908	25	0	,,	98	0	0
May, 1908	49	0 (15)	,,	181	0	0
June, 1908	46	0	,,	94	0	0
July, 1908	39	0	,,	78	18	0
August, 1908	30	0	,,	69	0	0
October, 1908	50	0	,,	124	0	0
November, 1908	41	0	,,	84	0	0
January, 1909	22	0	,,	21	18	0
Total	1,401	11	,,	4,151	4	6

(1) Dollied. (2) Mr. Webb has returns for 363 oz. dollied by blacks. (3) Cocoa Creek. (4) Mullock (screenings). (5) Headings. (6) *Fide* Mr. Stuckey. Not given by Warden. (7) Seconds. (8) Given by Warden as 29 tons 11 oz. (9) Formation from No. 3 shaft. (10) Surface. (11) Warden gives 21 tons 10 cwt. (12) Gains and party (headings). (13) This and the following returns are from the main shaft, Starcke United. (14) From east stope at 80-ft. level. Crushed at Charters Towers, where the tailings were sold for 10s. 6d. per ton, making the total value of the crushing £9 12s. 10d. per ton. (15) Underhand stoping, 115-ft. level.

Last Hit No. 1 W.

The surface rubble, shed over an area a chain in diameter, from the continuation of the P.C. line, has been removed and crushed; besides which two shafts were sunk, one on the main line, where a west-south-west branch leaves it (about a chain west of the P.C. No. 1 shaft) and a second ¾ ch. to the west-south-west. Both have been filled in, but the latter is said to be 40 ft. deep. When the claim was first taken up three men were kept at work dollying, the average result per week being 30 oz. of gold.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
July, 1898	...		crushed for	120	0	0 (1)
October, 1898	20	0	,,	22	17	0
November, 1898	4	10 (2)	,,	3	12	0
December, 1898	20	0	,,	30	10	12
March, 1899	6	0	,,	4	3	7
July, 1899	14	10	,,	62	13	0
September, 1899	21	0	,,	19	11	6
October, 1899	75	0 (3)	,,	22	8	0
,, ...	60	0 (3)	,,	12	2	0
December, 1899	53	0	,,	11	9	0
March, 1900	200	0 (3)	,,	50	18	12
June, 1900	23	0 (3) (4)	,,	2	0	0
February, 1901	15	0	,,	18	0	0
March, 1903	4	0 (5)	,,	3	0	0
August, 1904	30	0 (6) (7)	,,	5	0	0
Total	546	0	,,	388	4	13

(1) Dollyings, *fide* Mr. Webb. (2) Warden "F. Quin." (3) Surface. (4) *Fide* Mr. Stuckey. Not given by Warden. (5) Given by Warden as No. 1 E. (6) Headings. (7) Warden gives 1 ton 10 cwt. for 5 oz.

Last Hit No. 2 W.

Two shafts, about 20 ft. apart and 50 ft. deep, have been sunk 2½ ch. west-south-west of the P.C. No. 1 shaft, but have both fallen in. It is stated that much driving was fruitlessly carried out here in search of the golden shoot, and besides much trenching has been done on the surface.

Output (1):

	Tons	cwt.		Oz	dwt.	g .
November, 1902	6	0	crushed for	4	16	0
December, 1902	10	10	,,	35	7	0
,, ...	10	0 (2) (3)	,,	0	17	0
May, 1903	8	10 (4)	,,	5	0	0
October, 1903	2	0	..	15	4	0
December, 1903	1	15	,,	3	2	0
January, 1904	20	0 (5)		2	10	0
Total	58	15	,,	66	16	0

(1) No dollyings. (2) Surface. (3) *Fide* Mr. Stuckey. Not given by Warden. (4) Seconds. (5) Headings.

Last Hit No. 3 W.

The return given below was reported to the Warden, but it is now not possible to locate the spot from which the stone was taken.

Output:

May, 1903—4 tons crushed for 4 oz. 16 dwt.

Last Hit No. 1 E.

A shaft has been sunk to 70 ft. below the surface on the east-west line proved by the No. 3 shaft of the P.C. At the bottom there is said to be a 3-in. leader carrying about ½ oz. gold per ton, but richer stone obtained above is believed to have been crushed with parcels from the P.C.

Output (1):

November, 1902—3 tons crushed for 3 oz.

(1) No dollyings.

Lily of the Valley.

The Lily of the Valley lies 1 mile north by east of the police reserve, and just to the north of the Duke of York lease.

The workings comprise two shafts, 25 ft. deep and ½ ch. apart, and an adit from the gully side, besides a large number of trenches and potholes.

Five separate shoots or pipes of gold-bearing stone have been found on this ground, within a distance of 2 ch., along the Duke of York porphyry. The gold occurs in quartz leaders on both sides, or either side of the dyke, but never in the rock itself, though the auriferous bunches on opposite sides are often connected by black seams. The country rock—a dark schistose slate near the porphyry—has been seamed with quartz, sometimes over a width of 2 ft., and is then known as "formation."

Output:

	Oz.	dwt.
1898—Dollied from surface stone (1)	70	0
October, 1899—4 tons crushed for	2	5
Total	72	5

(1) *Fide* Mr. Webb.

Lizzie Trembles.

The Lizzie Trembles leader crosses a belt of porphyry, about 10 ch. west-south-west of the Gold Mount workings.

Output:

July, 1899—2 tons crushed for 5 oz. 3 dwt.

Love's Duffer.

Love's Duffer workings are about 5 ch. north of the north-eastern corner of the Starcke Consols lease. Traces of gold are said to have been got on the surface; but a shaft, sunk 25 ft. in horny, bluish, silicified slate, failed to locate a reef.

Monte Carlo.

The Monte Carlo workings, formerly known as the Sea View, lie on the seaward side of the range, ¼ mile north of the Gladstone.

The workings are all now in a dilapidated state. The main or eastern, shaft is 55 ft. deep; the central shaft, 30 ft. to the west, is 30 ft. deep; and the western shaft, 45 ft. to the west of that, is 20 ft. deep. Some driving has been done from the main shaft and from the central, and there is a long trench adjacent to the western shaft.

Nothing definite can be made out of the reef, but in the western trench there were probably a number of bunches of quartz not more than 6 in. thick at most. The quartz here is rather more crystalline than usual, and emits, when broken, a strong odour of sulphuretted hydrogen. The quartz in the other tips is white, granular, and contains much partly replaced country. That from the deeper workings is bluish, and contains a little very finely disseminated pyrite. The country is a massive, micaceous, tuffaceous, and slightly schistose rock, tilted at a high angle to the west.

As showing the disadvantages under which the mine was worked it may be mentioned that cartage to the mill cost 10s. and crushing 25s. per ton.

Output:

	Tons	cwt.			Oz.	dwt.	gr.	
, 1898	...			crushed for	40	0	0	(1)
July, 1898 ...	12	0		,,	18	12	0	
November, 1898	12	15		,,	66	0	15	
August, 1899	125	0		,,	164	0	0	
October, 1899	36	0		,,	24	10	0	
February, 1902	7	10		,,	6	18	0	
April, 1902...	12	0		,,	4	0	0	
January, 1903	14	0	(2)	,,	3	9	0	
July, 1903 ...	20	0		,,	6	0	0	
September, 1903 ...	8	0	(2) (3)	,,	5	10	0	
October, 1903	20	0		,,	5	10	0	
Total	267	5		,,	344	9	15	(4)

(1) Mr. Webb's estimate of his crushings from the Sea View. (2) Headings. (3) Warden gives 15 tons. (4) The value of the Monte Carlo gold was usually 1s. per oz. greater than that from the other mines of the field.

Mountain Maid.

The Mountain Maid workings are near the cap of a high spur about 10 ch. north-north-east of the Duke of York lease.

The reef, which has a width of up to 9 in., dips 45° to the south-south-east. A shoot 20 ft. in length was located and two shafts, a vertical and an underlie, were sunk on it to a depth of 20 ft. Then an adit known as Besanti's was put in 100 ft. from the ridge side and drives were carried 10 ft. east and 30 ft. west from the end of it, along a leader of quartz up to 6 in. in thickness. Very rich dollying stone was obtained at the surface but deterioration appears to have been rapid as the depth increased. The adit at the entrance is in slate but the country adjacent to the reef is a micaceous tuff.

Output:

	Oz.	dwt.
1898—Stone dollied for	50	0 (1)
1899—Stone dollied for	25	0 (1)
March, 1899—5 tons (2) crushed for	6	8
Total	81	8

(1) *Fide* Mr. Webb. (2) Seconds from dollying.

Old Starcke Leaders.

When the exodus began to set in on the Old Starcke alluvial field, at the head of the Diggings Creek, an attempt was made by Mr. Dick's co-operative party to test a number of leaders, which had been located about a mile south-east of Mount Hetty and 5½ miles east-by-south from Munburra. The main leaders were three in number, about 10 ft. apart and ran north-east in quartz-felsite country, much kaolinised near the surface and not free from a north-north-east trending schistosity. The first work consisted in the excavation of a number of open-cuts, in which nothing can now be seen of the leaders.

Mr. Webb has records of 125 oz. of gold dollied from the surface stone; and gold-bearing specimens, shown me by him as from the leaders, indicate a high degree of similarity in the vein fillings here and in the vicinity of Munburra.

The co-operative tunnels or, more properly speaking, adits were put in from the creek level, within a chain to the south of the old surface workings. They have now caved-in but are said to be between 70 and 100 ft. long. Old prospectors state that the leaders came together within 20 ft. of the surface and their metal contents rapidly fell off, and that the gold obtained in driving the adits was a negligible quantity.

Poor Old Torres.

The Poor Old Torres claim (No. 105) is in the south-western corner of the Starcke Consols lease. An adit, 35 ft. long, intersects one of Weir's underlie shafts, which was continued for 40 ft. with Government aid. This shaft is now full of water, and a drive to the east on the adit level has been blocked up with mullock.

In the adit the reef is only 2 to 3 in. thick, with a well defined foot-wall and 3 or 4 in. of quartz-bearing formation on the hanging-wall. The quartz is creamy white, and exhibits thin lines of pyritous country.

Output:

September, 1902—7 tons 10 cwt. (1) crushed for 2 oz. 6 dwt.

(1) The Warden's return is 7 tons, raised by Rapport and Robbins.

Queen Alexandra.

The Queen Alexandra reef strikes along the southern boundary of the Boomerang United, one of the leases of the Starcke United Company. Outside of forfeited lease No 10, it is known as the Edna, and as such has been described above.

The main underlie shaft on the reef is 80 ft. in total depth. This appears to be in a safe condition, but a descent could not be made because of the ladders having been removed. Mr. Webb states that at the 80-ft. level there are prospecting drives for 50 ft. east and 50 ft. west, and at the 50-ft. level there are drives for 80 ft. east and 40 ft. west; and that above the 50-ft. level some stoping has been done.

The dip of the reef is usually about 45 degrees northwards, but the strike varies between west-north-west and north-west. The quartz at grass is crystalline, banded in parts, and contains flakes and seams of dark mineral residual from inclusions of country. There are traces of galena in the quartz, which, with the greenish sulphurous oxidation stains, is looked upon as the best indication of the presence of gold. Beside the reef itself there must be some width of formation. The country at the surface is light coloured arenaceous tuff (?), but at a depth changes to dark blue and becomes pyritous. It is much slickensided internally. Porphyry must also have been met in some of the underground workings.

Output:

	Tons	cwt.		Oz.	dwt.
May, 1903	8	5	crushed for	40	12
July, 1903	10	0 (1)	,,	5	10
August, 1903	31	0	,,	67	0 (2)
October, 1903	20	10 (3)	,,	35	19
December, 1903	17	0	,,	42	10
August, 1904	3	0	,,	3	0
Total	89	15 (4)	,,	194	11 (4)

(1) Seconds. (2) Warden gives 65 oz. 16 dwt. (3) *Fide* Mr. Stuckey. Not given by Warden. (4) Total given as 152 tons crushed for 296 oz. 1 dwt.

Rapport.

Rapport's porphyry shaft lies 2 ch. south of the south-eastern corner peg of G.M.L. No. 17 and is now within the Starcke United Company's lease. It has been filled in and nothing can be seen of the leader worked, but the country rock is a white, almost fissile, porphyry, belonging to the main belt found at intervals through the whole of the property.

Output (1):

2 tons crushed for ½ oz.

(1) Local report.

Reine d'Or.

The Reine d'Or is located near the crest of a sharp spur, ½ mile north-east-by-north from the police reserve. A 10-ft. pothole and a pit have been sunk on a few east-west ferruginous stringers in arenaceous and micaceous, well-bedded, tuff. There are also trenches on a leader running north-west, 10 ch. to the south-west of these workings. A little gold is said to have been got here by dollying.

Rio Tinto.

The Rio Tinto shoot, which has been worked over a distance of nearly 2 ch., occurs in the centre of the Starcke Consols lease. The southern part of the shoot is sometimes referred to as the La France, a claim on it having been so named.

Nelson's shaft at the northern end is inaccessible, but some particulars are available as to Albert's shaft at the southern end. (*See* Starcke Consols.)

Output:

	Tons	cwt.		Oz.	dwt.	gr.
December, 1898 (1)	5	0	crushed for	16	5	12
May, 1898	23	0	,,	73	14	6
August, 1899	20	0	,,	54	4	0
September, 1899	3	0	,,	3	12	10
November, 1899	50	0	,,	109	7	0
April, 1900	3	0	,,	2	4	0
August, 1901	27	0	,,	15	15	0
November, 1901	7	0 (2)	,,	10	9	0
December, 1903	6	5	,,	20	6	0
August, 1904	8	0 (3)	,,	20	10	0
November, 1904	5	0	,,	9	2	0
December, 1904	5	0	,,	6	18	0
Total	162	5	,,	342	7	6

(1) Much stone dollied, but no records. (2) Given by Warden as La France. (3) Mr. Stuckey says La France.

Rio Tinto No. 1 N.

The return given below probably should be attributed to the open-cut at Nelson's shaft.

Output:

	Tons	cwt.		Oz.	dwt.	gr.
June, 1898	4	10	crushed for	5	15	12

Rio Tinto No. 2 S.

(*See* Weir's.)

Ruby United.

The Ruby United workings extend along the western side of the Starcke United Company's lease No 21, over a distance of 7 ch. The southern end of the reef was worked by the Boomerang No. 1 W. and is described under that heading.

In the north-western workings there was about a foot of crushing stone, but at 50-ft. depth in the inaccessible main shaft there is said to have been between 2 and 3 ft. width of quartz. The country rock is a micaceous sandstone and altered shale striking north 15 degrees east.

Output:

	Tons.		Oz. dwt.
, 1898	4 (1)	crushed for	8 0
May, 1900	11 (2)	,,	4 9
Total	15	,,	12 9

(1) *Fide* Mr. Starcke. ( ) Test parcel from north-western workings.

St. Patrick.

The St. Patrick workings are in a gully in the northern part of the Starcke Consols lease beyond the Rio Tinto, but apparently on the same line.

Four shafts have been sunk to a depth of about 60 ft.: one, 3½ ch. north of the Rio Tinto adit, struck heavy water; a second is 2 ch. further north; and ½ ch. beyond are two others 15 ft. apart. Ground has been stoped out between the last two and caving has since taken place, exposing between 2 and 3 ft. width of formation, with well defined slickensided hanging wall. The quartz raised and still at grass is white and crystalline or in places crystallised, and shows lines of included country. Oxidation stains indicate the presence of mispickel in the reef here. The country from a depth is a bluish, quartz-veined, crushed rock, but at the surface is an arenaceous schist.

The formation in the next shaft to the south is up to 5 ft. wide, with a leader on the footwall diping 45° to the west. Some stoping was done in this shaft below the 25-ft. level. The comparatively great thickness of formation met here encouraged the prospectors to have a trial crushing of 10 tons, which is said to have yielded 7 dwt. per ton.

Output:

	Tons cwt.		Oz. dwt.
October, 1899	28 0	crushed for	85 0
October, 1900	11 10 (1)	,,	3 0
November, 1900	48 10	,,	62 10
January, 1901	21 10	,,	64 10
Total	109 10	,,	215 0

(1) Seconds.

Sea View.

(*See* Monte Carlo.)

Slattery's.

Slattery's P.A. No. 50 was located in the southern part of what is now the Starcke Consols lease.

The two shafts, which were sunk about 30 ft. on the underlie and which are ½ ch. apart, have now fallen in, but it is understood that the reef worked was 7 or 8 in. thick; it was well defined and dipped 45° to the south-west, while the country has a north and south strike, with a dip of 90°. The shoot must have been a very short one for trenches to the south-east failed to locate pay ore; and further the gold cut out within 30 ft. of the surface.

Output:

July, 1899—8 tons (¹) crushed for 19 oz. 6 dwt.

(¹) P.A. No. 50.

Starcke Consols.

The Starcke Consols is a lease (G.M.L. No. 23) of 28½ ac., lying a little less than ¾ mile north of the police reserve. This lease includes within its boundaries the following workings and claims: Dyer's, St. Patrick, Rio Tinto (and La France), Weir's, Slattery's, and Poor Old Torres—all elsewhere described.

The shoots of auriferous stone on all of these (except Dyer's) are connected with a north-south belt of porphyry; and a peculiar and unusual feature is that the best gold is found where the reef is thickest.

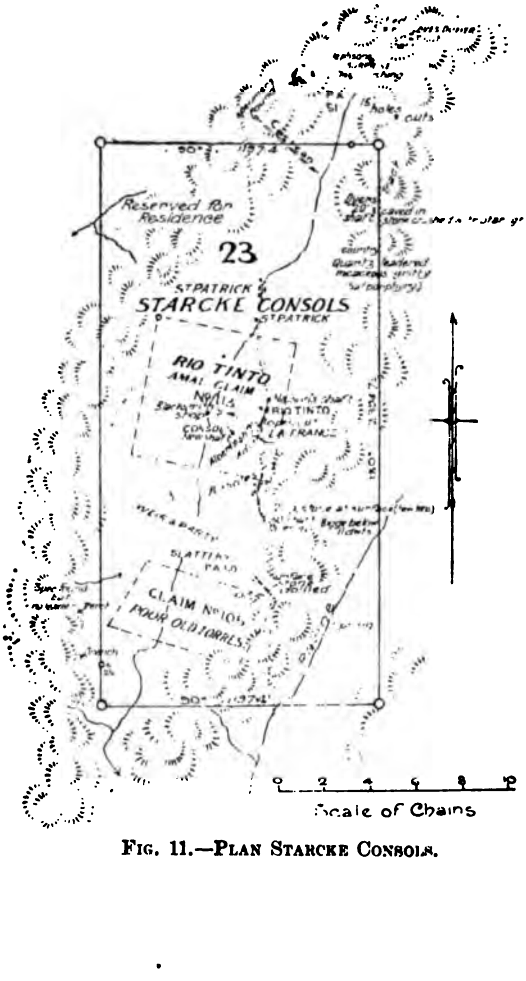

FIG. 11.—PLAN STARCKE CONSOLS.

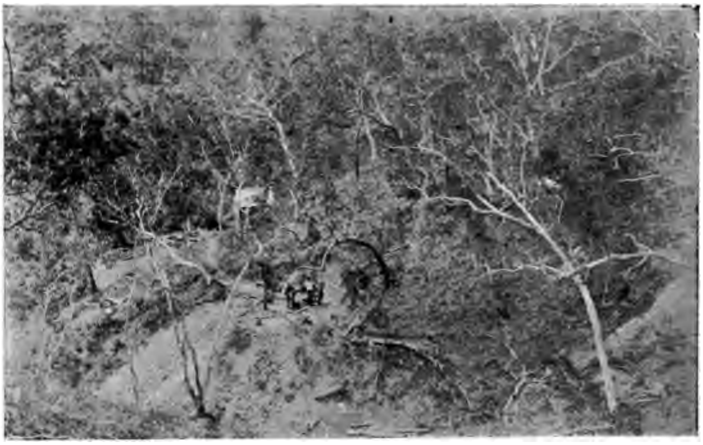

Photo., L.C.B.

FIG. 10.—THE STARCKE CONSOLS VERTICAL SHAFT AND THE MOUTH OF THE RIO TINTO ADIT (IN THE GULLY BEHIND).

The first work done by the leaseholders was the driving of the Rio Tinto adit to Albert's workings on the La France shoot. Albert's shaft is cut by the Rio Tinto adit, 100 ft. in from the hillside. (*See* Fig. 12.) The workings below the adit were lost by the caving-in of the walls during the wet season, but, as they had been drained by the operation of the Consols new shaft, we found it possible to descend to the intermediate level and enter the old stope on the south. It was from here the 69½ tons of stone, mentioned below, was taken.

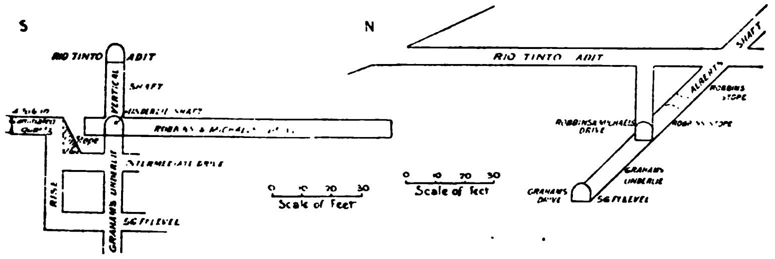

FIG. 12.—THE RIO TINTO WORKINGS.

The formation, where it crosses the adit, is only 2 ft. in width (comprising a 4 in. clayey seam on the hanging-wall, 15 in. black country veined with quartz and 3 in. crushed country on the foot-wall), but there is a strong pug vein 5 ft. 6 in. within the foot-wall slate. The latter is 1 to 3 in. in thickness and is accompanied by a thin leaderlet of quartz. In the top of the rise from the 40-ft level below the adit, 4 to 15 in. of iron-stained, blue-laminated quartz is showing beneath a 10 ft. quartz-veined formation. The ground was in too insecure a state for any hammering to be done, but a few chips taken by the leaseholders were dollied with unsatisfactory results. This was anticipated, for Robbins and Michael found the reef to improve as they sank on it, until 2 oz. stone was reached at 14 ft. below the adit.

During my visit an attempt was made by the leaseholders to intersect the Rio Tinto, or La France, shoot by sinking a vertical shaft to a depth of 70 ft., but unfortunately a blank was struck. Instead of a reef a formation, or crush zone, 5 ft. across, was found after cross-cutting 7 ft. from the shaft. This contains only lenticular bunches of quartz with a trace of gold. The foot-wall of the formation dips 45° to the west-north-west and is formed of quartzite with dark green greasy faces. The hanging-wall slate country is quartz-veined for some distance from the formation, and one vein 6 in. thick was met in the shaft. This cannot be seen owing to the timbering, but is said to have prospected well.

The reason for choosing the present site for the Starcke Consols shaft is not self evident. It is at the southern end of the shoot, as can be seen from the surface workings, and the payable stone has been worked out to within 20 ft. of the level, where it should intersect the formation. The only use that can be made of this shaft now is to sink it to the foot-wall of the reef and then drive to the north. Having decided on sinking a vertical shaft, although an underlie is always preferable for prospecting, a little consideration would have shown the advisability of deciding on a site across the creek to the west of the blacksmith's shop.

Output (1): For early returns *see* La France and Rio Tinto, Poor Old Torres, St. Patrick, Slattery's, and Weir's.

March, 1908—69 tons 10 cwt. crushed for 125 oz: £4 per oz.

Starcke United.

The Starcke United Gold Mining Company was floated in July, 1907, the total number of shares being 70,000, each of a nominal value of 2s. 6d., and of these 3s. 7d. are paid up. It holds three leases (G.M.Ls. Nos. 17, 21 and 24) aggregating 30½ ac. and lying 50 ch. north-north-west of the Munburra police reserve.

The greater number of workings are on the Boomerang United lease, but the deepest shaft and the latest worked is on the Last Hit. The Starcke King lease was taken up chiefly to obtain control of the country between these leases and includes the greater part of the forfeited leases known as the Queen Alexandra and the Edna.

At least 15 distinct veins or branches have been worked at one time or other to a greater or less extent; but only four of them—the Last Hit, Ruby United, Boomerang, and Queen Alexandra—are of any importance, and these have been described under their respective headings.

The company at the time of my visit was sinking on the Last Hit, but operations have, since January, 1909, been suspended owing to disputes between Cooktown and Gympie shareholders, bringing about frequent changes of management. The capitalisation leaves no margin in case of unremunerative work having to be carried out. There is little doubt that, had the ground been held by one company from the start, active operations would now have been the order of the day, provided that reserves had been laid aside out of profits. It will be quite another matter for a company to begin operations now, in face of the doubt as to the tenor of the stone in the lower workings and the insecure state of the working places themselves.

The Starcke United Company has, however, proved on the Last Hit P.C. the existence of a shoot of payably auriferous quartz 50 ft. in length, extending to a depth of at least 125 ft. It is quite reasonable to suppose that, had the company undertaken work on the Last Hit No. 1 E., the Boomerang and the Queen Alexandra, other

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(1) *File* Mr. Stuckey.

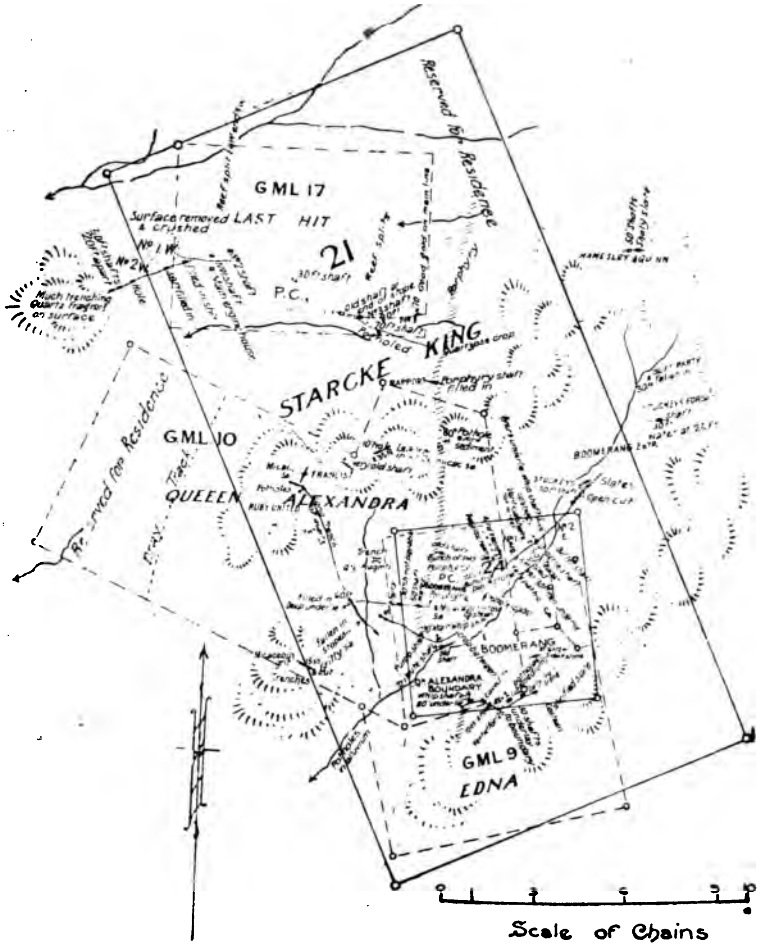

FIG. 13.—PLAN STARCKE UNITED, WITH LEUCOPHYRE AND TUFF BELT.

payable shoots would have been located, for it is most unlikely that such very rich stone, as was there won on the surface, would become almost barren within 100 ft. of the surface. The surface indications at any rate warrant some prospecting being carried out on these lines below the old workings before abandoning the property. The company is unfortunate in not possessing a battery, yet I should not care to advise that one be purchased until a certain ore-reserve has been proved. Stuckey's battery was held by the company under lease during the greater part of 1908 and is sufficient for the testing of the stone raised, provided that sampling and assaying are carried on in conjunction with crushing.

Output: *See* Boomerang, Edna, Francis, Last Hit, Queen Alexandra, Rapport, and Ruby United.

Starlight Gully.

Dyer sank a shaft in Starlight Gully about 15 ch. north-north-east of the Starcke Consols lease and is said to have raised about 10 tons of quartz for a very disappointing return.

Slattery's adit on P.A. No. 53 is about ¼ mile north of the same lease.

Output (1):

	Tons cwt.		Oz. dwt.
October, 1899	4 0	crushed for	1 10
November, 1899	4 5	,,	4 5½
Total	8 5	,,	5 15½

(1) P.A. 53, and possibly including stone from Dyer's.

Surprise.

Jephson's Surprise (P.A. No. 51) is only about 4 ch. north of the Consols. The leader strikes east-north-east and is practically vertical, whereas the strike of the country is north and south. The main shaft is over 40 ft. deep and is now holding water. Near the top of it can be seen 3 in. quartz but below there is a total width of 15 in. quartz and formation. This has been trenched for 15 ft. to the west-south-west, beyond which it split up into stringers. Some underhand stoping has been carried out, about 20 ft. to the east-north-east of the shaft, but no defined reef can be seen there.

Output:

	Tons cwt.		Oz. dwt.
June, 1899	15 0	crushed for	104 5⅓
September, 1899	1 10	,,	1 1
April, 1900	4 0	,,	3 17
Total	20 10	,,	109 3⅓

Tucker's.

Tucker's lies about 3 miles north-west of Munburra, on a low gravelly ridge, on the surface of which several small rich specimens have been found, within an area 3 ch. in diameter.

One shaft was sunk to a depth of 40 ft. and another 2½ ch. to the east-north-east is 20 ft. deep. There are a great number of costeans and trenches between these shafts and beyond them, but no defined run of stone has been located. It is probable that the gold-bearing quartz occurs as small bunchy leaders. The country rock is a micaceous sandstone or tuff striking north-north-east.

Output:

March, 1899—3 tons crushed for 3 oz. 16 dwt.

Uncle Sandy.

Uncle Sandy (forfeited M.L. No. 132 of 5 ac.) lies in the dense scrub 2½ miles east-south-east of Munburra.

An old shaft has fallen in but the top of the stope can be inspected. The lode, which comprise 6 in. of quartz-bearing formation between good walls (clayey iron-stained country), runs east and west, dipping 85° to the south. An adit ½ ch. to the west was continued 30 ft. beyond the shaft but has now caved-in. It is said that a winze was sunk 10 or 12 ft. from the end of the adit and that some stoping was done above it.

The mine was worked for gold but, the ore containing some antimony, it was re-opened by an English firm some years ago and a few tons were shipped for experimental purposes but nothing further was done. A few specimens containing stibnite are obtainable on the tip but the greater part of the sulphide had been changed into valentinite. It is, however, acknowledged by the prospectors connected with the opening of the mine that the percentage of antimony is low.

Output:

	Tons.		Oz.	dwt.
October, 1899	4	crushed for	4	0
January, 1900	12 (1)	,,	5	7
January, 1906	9	shipped contained 9 per cent. (2) antimony.		

(1) Picked stone freed from antimony ore. (2) *Fide* Mr. Webb.

Weir's.

Weirs, or the Rio Tinto No. 2 S., workings are on the ridge 2 ch. south of the La France adit (*see* Starcke Consols). They comprise a number of caved-in potholes and shafts, one of which was 30 ft. deep. A small quantity of rich stone was found along the surface—the shoot having a length of at least 2 ch.—but below the reef increased greatly in width and the values fell to 11 dwt.

Output:

	Tons	cwt.		Oz.	dwt.
September, 1899	3	0 (1)	crushed for	11	7
June, 1899	2	12 (2)	,,	5	5
Total	5	12	,,	16	12

(1) Rio Tinto No. 2 S. (2) Weir's.

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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.

(B. DUNSTAN, GOVERNMENT GEOLOGIST.)

PUBLICATION No. 215.

CLONCURRY COPPER MINING DISTRICT.

PART 2.

WITH 1 MAP, 76 PLANS, AND 25 FIGURES.

BY

LIONEL C. BALL, B.E.,
ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1908.

HARVARD
17465

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ERRATA.

◆

Page 12.—Above **Labour Victory (R.C. 29)** *read* Agate Downs Group.

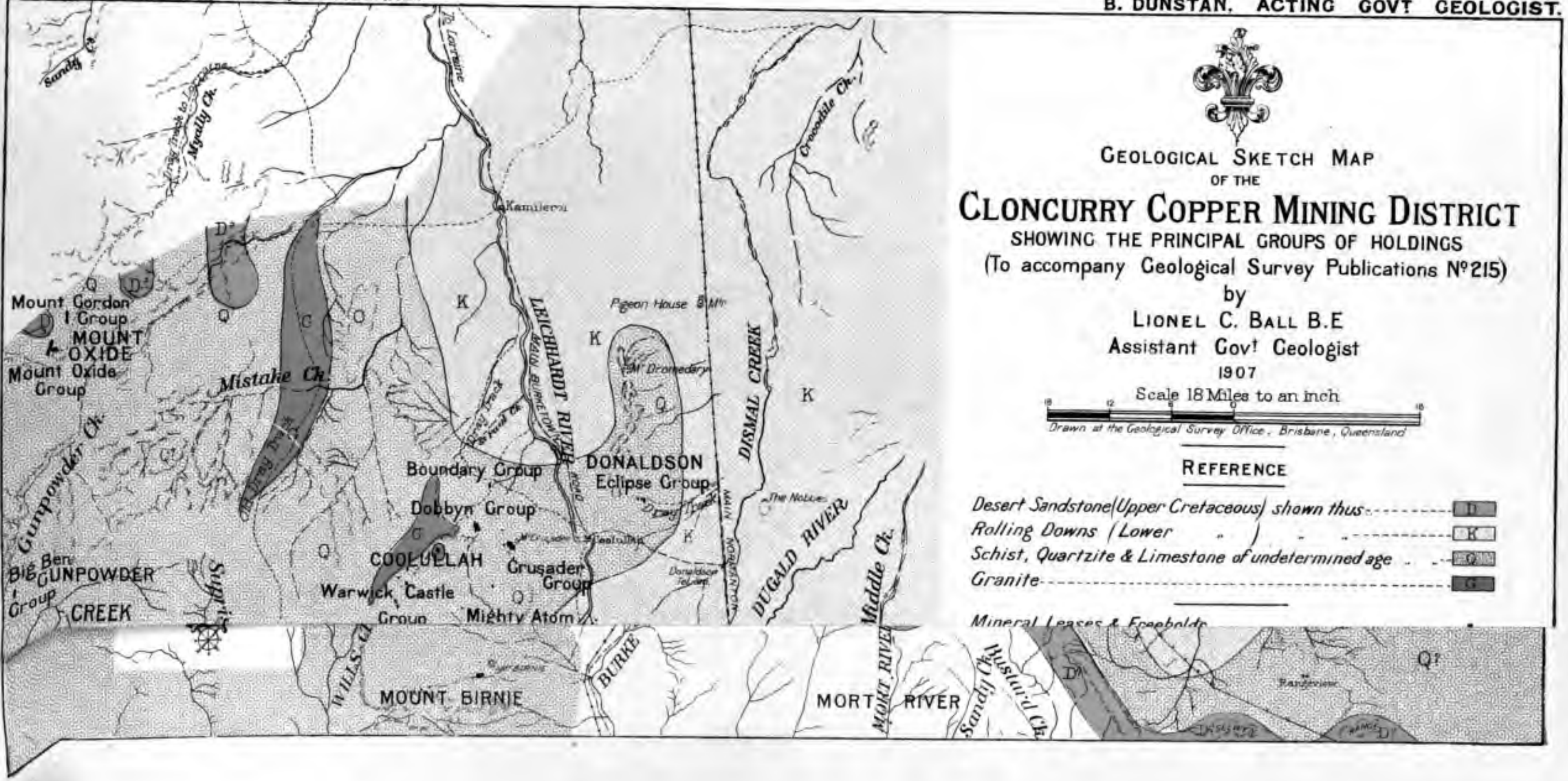
Page 17.—On Plan of Duchess and Ivanhoe Groups, for No. 3 on M.L. 427 *read* No. 2.

Page 103.—For M L. 161 *read* M.C. 161.

Frontispiece.—There is insufficient evidence to warrant the inclusion of the three patches of Desert Sandstone (marked with a query) between Mount Oxide and Kamileroi, and they should therefore be omitted.

Frontispiece.—An area of granite about 15 miles long and 10 miles wide should be shown between the heads of the Dugald River and Cabbage-tree and Prospector Creeks.

GEOLOGICAL SURVEY OF QUEENSLAND. B. DUNSTAN, ACTING GOVT GEOLOGIST.



GEOLOGICAL SKETCH MAP
OF THE
CLONCURRY COPPER MINING DISTRICT
SHOWING THE PRINCIPAL GROUPS OF HOLDINGS
(To accompany Geological Survey Publications Nº 215)
by
LIONEL C. BALL B.E
Assistant Govt Geologist
1907

Scale 18 Miles to an inch

Drawn at the Geological Survey Office, Brisbane, Queensland

REFERENCE

Desert Sandstone (Upper Cretaceous) shown thus ---------- D
Rolling Downs (Lower ") " " ---------- K
Schist, Quartzite & Limestone of undetermined age " ---------- Q
Granite ---------- G

Mineral Leases & Freeholds

CLONCURRY COPPER MINING DISTRICT.*

PART II.

◆

MINERAL HOLDINGS.

This part of the report is limited to individual descriptions of the mines, all other matters having been considered in the first part.

Though the whole country has been divided into counties, parishes, runs, and blocks, these divisions are seldom made use of in locating the mines. Locally, each part of the district is known by the name of some natural feature, such as a mountain (Soldier's Cap) or a river (Corella), or by that of a settlement (Hampden). In describing the mines it is usual to refer those on a single lode or within a circumscribed area to a single group. The local nomenclature, where consistent, has been followed in this report in the naming of districts and groups, the former coming below in their order from south to north.

The leases and freeholds mentioned below have been located on a map of the Cloncurry district published with the Annual Report of the Under Secretary for Mines for the year 1906;† and most of the groups are shown on the small map attached.

---

* This report has already appeared in the *Queensland Government Mining Journal* of June, 1907, *et seq.*, but has been rearranged for this publication, in which will also be found some additions, chiefly of mineral holdings not visited by me.

† **Later issued as G.S.Q. Publication No. 213.**

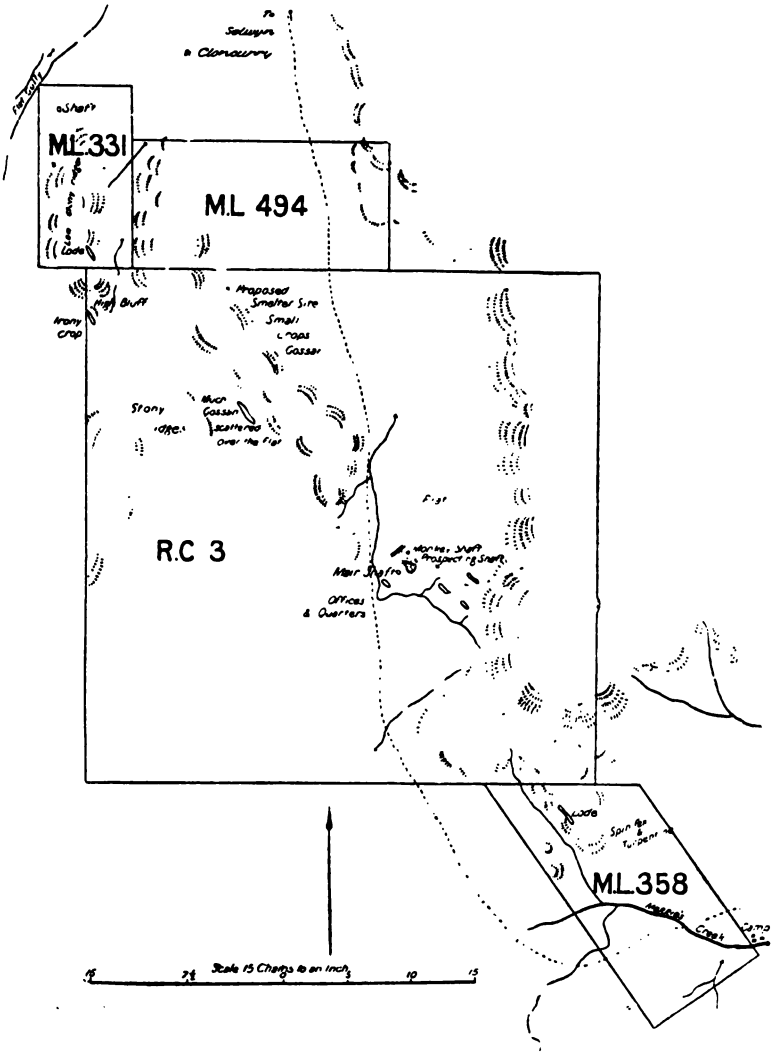
MAGGIE'S CREEK.

Maggie's Creek, which rises on the low divide, known as the Selwyn Range, has a run northwards into the Cloncurry River of little over ten miles.

The only mines working at the end of the year 1906 were the Mount Elliott and the Labour Victory.

MOUNT ELLIOTT GROUP.

The Group includes reward claim No. 3 and mineral leases Nos. 331, 358, and 494.



SKETCH PLAN, REWARD CLAIM AND LEASES, MOUNT ELLIOTT.

Mount Elliott (R.C. No. 3, Etc.).

(Mgr., G. A. Waller).

LOCATION.

The claim and leases are located on a low divide between two of the upper branches of Maggie's Creek, a short tributary of the Cloncurry River, 58 miles south of Cloncurry and 1,400 ft. above sea level.

The new township of Selwyn has lately been laid out, ½ mile north of the workings.

The mine is connected with Cloncurry by a good road running down Maggie's Creek, across the Cloncurry River, into Hampden; then across the Florence River and down the Cloncurry River (crossing it twice) to the township. An alternative route (but now seldom used) is down the Cloncurry River, *viâ* Devencourt, across the Dugald River to Duck Creek.

The latest proposed tramway route from Mount Elliott leaves the coach road at the Florence, and makes a slight detour to the westward to take in the Duck Creek group.

TOPOGRAPHY.

The Mount Elliott divide crosses a shallow valley carved out of an old pene-plain, of which only flat and topped ridges and hills. rising 150 ft. above the present valley bottom, now remain. The strata for some depth below the surface of the old pene-plain have been rendered very ferruginous, and are especially subject to irregular weathering, allowing the formation of caves.

Mount Elliott, being near the divide, is one of the driest localities of the district, and it has been necessary to devise methods of water conservation to ensure the successful exploitation of the mine. One of the first proposals was to pump water from a well at the Boomerang waterholes, six miles down Maggie's Creek. It has also been proposed to construct a dam in one of the gorges at the head of Maggie's Creek, but the present supply, which is believed to be sufficient, is obtained from two wells a short distance south-east of the mine.

HISTORY.

During the second quarter of 1901 Mount Elliott was placed in the hands of a Melbourne Option Syndicate, who sank a shaft 50 ft. and, by crosscutting during the third quarter, proved 37 ft. of solid ore—at a cost of £6 per foot.

In the following three years little was done beyond well sinking, but toward the end of 1905 the shaft was deepened to 100 ft.

The Linedale Syndicate then secured a working option for 12 months, and early in 1906 a company was floated in Melbourne. Extensive developmental work was at once begun, and carried on till the end of the year. The unusually complete surface plant necessary in so remote a locality is now in full working order, and the erection of a smelter is being proceeded with.

From the manager's reports published in the Brisbane Press since my visit, the following has been culled:—

22/2/07.—Western crosscut at 185 ft. level back from No. 1 winze (below No. 2 crosscut) advanced 18 ft. in sandstone, with iron pyrites in the end, and a lode formation 2 ft. wide, with veins of rich ore 6 in. wide (footwall lode?).

No. 2 inclined shaft opencut 19 ft. deep.

2/3/07.—Footwall veins struck at 32 ft. in crosscut from main shaft at 185 ft. level 4 in. to 2 ft. wide—40 % copper.

Hard ferruginous ore struck in crosscut at 23 ft. from the No. 1 winze—4 % copper

15/3/07.—Low grade gossan struck at 40 ft. in crosscut from main shaft at 185 ft level—4 ft. 6 in. wide.

Footwall vein in north-western drive 4 ft. wide—45 % blk. oxide and glance.

No. 2 inclined shaft 40 ft. deep.

29/3/07.—Main ore body cut in north-western drive (total 17 ft.) on 185 ft. level at 10 ft. from the shaft—7 % copper.

27/4/07.—Footwall vein in 185 ft. level main crosscut composed of kaolin, with two principal bands of rich glance, totalling 4 ft. in thickness, and averaging when bagged 41 % copper, but pinched out northwards in 15 ft. Crosscut then put across the lode to connect with No 1 winze, proving main ore body to be 18 ft. wide, and proved for 30 ft. north-west from the main crosscut. [Mr. Waller kindly sent me this information.]

1/5/07.—North-west drive (125 ft. level)* 30 ft. long in hard ferruginous ore, containing 2 % Cu.; 9 ft. drive on hanging-wall kaolin.

Unfortunately my visit was a hurried one and made during Mr. Waller's absence, and consequently without his guidance and local knowledge. His officers, however, gave me every facility in making the examination.

LITERATURE.

The full titles of the reports, numbered as below, will be found in the Introduction.

4. Mr. Cameron refers briefly to Mount Elliott, the only work done at the time of his visit being the two trenches at opposite ends of the main crop. He however, considered the crop worth testing by adits.

10. Mr. Waller, in his first report, goes fully into the general description of the property, including locality, geological features, work done, probable ore available, water supply, &c. The only workings described are those connected with the prospecting shaft; but, taking the area of the crop as 3,600 sq. ft., and knowing the ore to bulk 11 cub. ft. to the ton, Mr. Waller computes the probable ore above the 127 ft. level as 40,000 tons, of an average value of 20 to 25% copper.

14. In his second report Mr. Waller fully describes the workings. His resampling gives slightly different results to those first obtained, and he now estimates the average contents as 16·4% copper and 2 dwt.

---

* Meant for 185 ft. level? L.C.B.

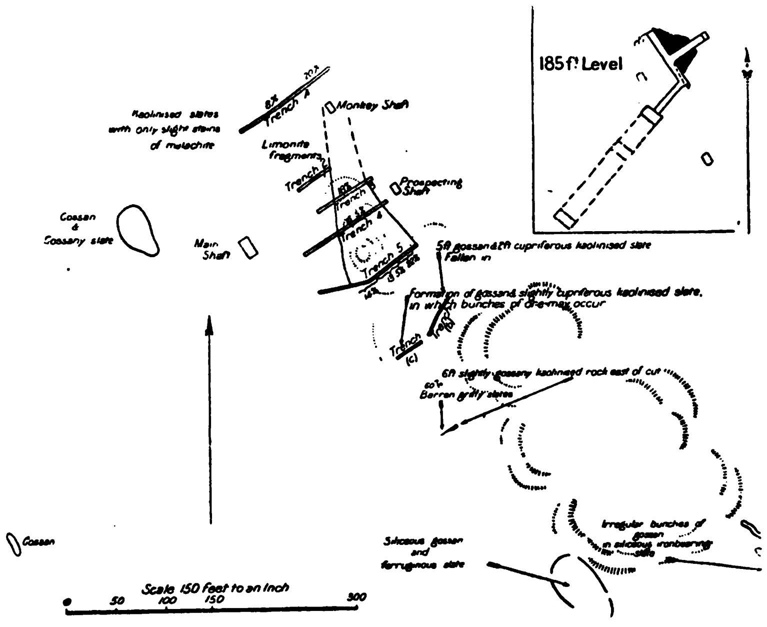
gold per ton, but the additional work done allows him to calculate the ore in the main body above the 125 ft. level as 45,000 tons. This, however, appears to only partly include the rich kaolin ores referred to.

Area.

Reward Claim No. 3 on which the workings lie is square and 160 ac. in area. Mineral Lease No. 331 of 10 ac. at the north-western corner of the reward claim and M.L. 358 of 20 ac. at the south-western corner were taken up on the line of strike of the ore bodies. M.L. No. 494 of 20 ac. has been secured as a works site.

Development.

The north-western trench (No. 1 or *a*) is 20 ft. north-west of the monkey shaft, and is 1 ch. in length.


185 ft Level
Kaolinised slates with only slight stains of malachite
Trench A
Monkey Shaft
Limonite fragments
Trench 2
Trench 3
Trench 4
Trench 5
Prospecting Shaft
Gossan & Gossany slate
Main Shaft
5ft gossan & 2ft cupriferous kaolinised slate
Fallen in
formation of gossan & slightly cupriferous kaolinised slate, in which bunches of ore may occur
Trench (c)
Trench (b)
6ft slightly gossany kaolinised rock east of cut
60°
Barren gritty slates
Gossan
Siliceous gossan and ferruginous slate
Irregular bunches of gossan in siliceous ironbearing slate
Scale 150 feet to an inch
0 50 100 150 300

SKETCH PLAN, SURFACE AND 185-FT. LEVEL, MOUNT ELLIOTT.

The following four trenches have been opened since my inspection:—

No. 2 trench, 50 ft., south-east of No. 1 is 30 ft. long.
No. 3 trench, 20 ft. beyond, is 50 ft. long.
No. 4 trench, 25 ft. beyond, is 70 ft. long.
No. 5 trench, 35 ft. beyond, is 90 ft. long.

The eastern trench (No. 6 or *b*), 35 ft. long, about 10 ft. east of the main crop.

The south-eastern (*c*) trench, 25 ft. long, is 6 ft. south-west of the eastern trench.

The southern trench (*d*) is 1 ch. to the south-east of the trench (*c*).

The prospecting shaft is 125 ft. east of the brace of the main shaft. It is vertical to the 125 ft. level, and then follows the underlying footwall to the 212 ft. level, where a crosscut was put in 16 ft. to the north-east. Its total depth is 227 ft. There are also at the 50 ft. level crosscuts north-east and south-west 6 and 52 ft. respectively.

The monkey shaft is 70 ft. north-west by north of the prospecting shaft. It is vertical to the main drive on the 125 ft. level.

The main shaft (5 ft. x 10 ft. clear of timber and three compartmented) has been sunk 197 ft. in the footwall with an underlie of 60°. At 121 ft. below the brace a main crosscut, 45 ft. in length connects with the main drive, known as the 125 ft. level. This drive is 172 ft. in length, and from it four crosscuts have been opened to the north-east. No. 1, 54 ft. in length, is 40 ft. south-east of the main crosscut; No. 2, 60 ft. in length, is 30 ft. north-west; No. 3, 50 ft. in length, is 100 ft. to the south-east; and No. 4, 65 ft. in length, is 65 ft. north-west. A branch drive 27 ft. long and known as the western (west 10° north) drive, leaves the main drive 60 ft. north-west of the main crosscut. It is next proposed to open out at the 168 ft. level.

Mr. Waller proposes to work the deposit by open cut to a depth of 125 ft., more especially owing to the scarcity of timber—an expensive item in any other system of mining. Another inclined shaft is to be sunk, and by it the ore will be raised to the smelters to be erected on the hill to the east of the mine.

OUTPUT.

Total, 1906—182½ tons.

MAIN ORE-BODIES.

The main outcrop, which rises abruptly 20 ft. above the surrounding flats, is 60 ft. in width at the southern end, and gradually tapers northwards to 20 ft. in a distance of 90 ft. (exact measurements are not possible because of a covering of loose talus).

The ore looks rather siliceous externally, but is found on breaking to consist of limonite (passing into red jasperoid), both barren and with disseminations and minute veinlets of cuprite and malachite, the former sometimes dendriform and the latter chiefly as amorphous encrustations. A little chrysocolla is found in cavities, and atacamite crystals are dusted over crystallised calcite on cracks in the limonite from the prospecting shaft. The presence of gold has been proved by assay, and one speck was noticed embedded in cuprite in a specimen collected by me. Some chalcedonic silica occurs as linings on joints, stalactitic in places, and also as radiating bunches and veins easily separable from the limonite. The comparative youth of these siliceous deposits is shown by their having been precipitated round stalactites of chrysocolla (Fig. 1), which must have leached out of the gossan, and their chalcedonic nature is indicative of their having been deposited within the zone of weathering. The crop has been trenched since my visit, and samples have been assayed as below:—

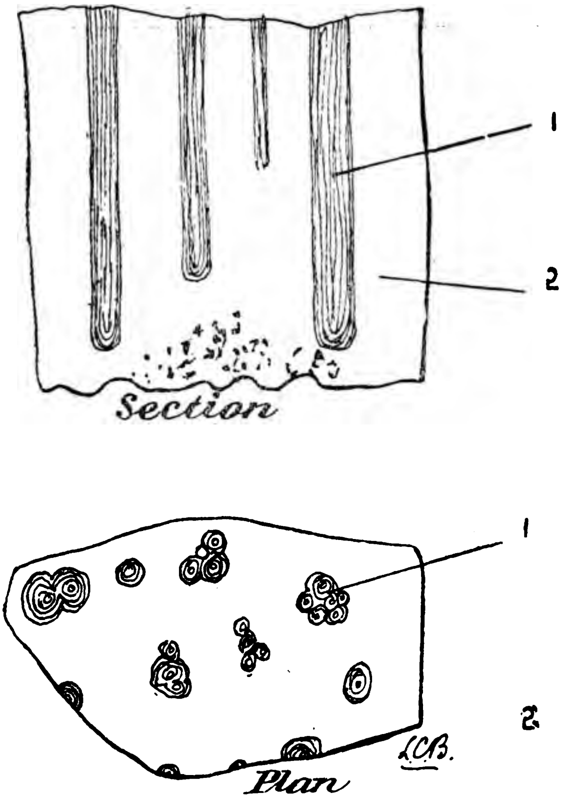
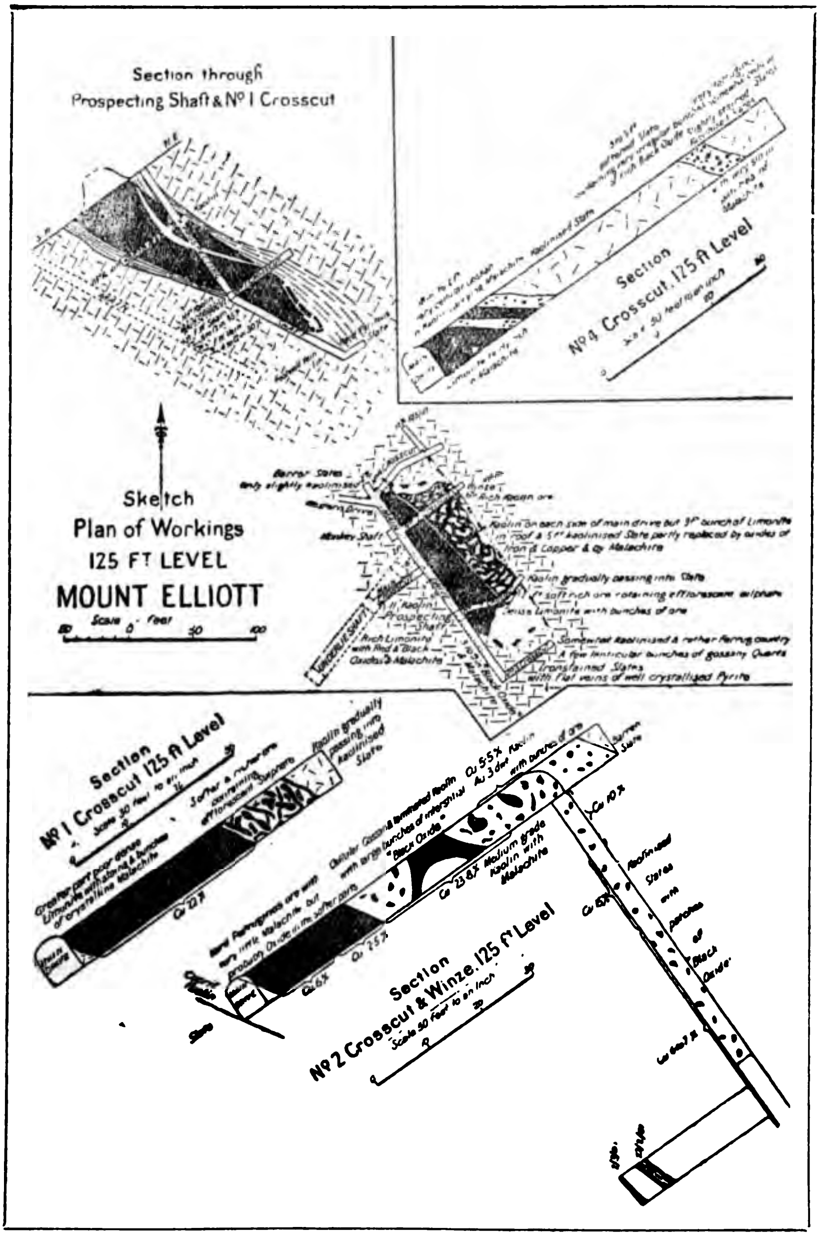


FIG. 1. (NATURAL SIZE)—SECONDARY ORE, MAIN CROP, MOUNT ELLIOTT.

(1). *Stalactitic chrysocolla.*
(2). *Chalcedony enclosing chrysocolla.*

No. 3 trench, 30 ft. width of ore—
    Copper 18% and gold 3 dwt. per ton.
No. 4 trench, 40 ft. width of ore—
    Copper 16·5% and gold 2 dwt. per ton.
No. 5 trench, 58 ft. width of ore at southern end of crop—
    Copper = 15·2% and gold = 2 dwt. per ton.

The prospecting shaft, which was begun in the hanging-wall country, was inaccessible to me, but from Mr. G. A. Waller's reports it is understood that the ore-body was cut at 40 or 70 ft. (it is not quite clear which) below the surface, and the footwall kaolin at 115 ft. The ore in the shaft averages 17·8% copper, with a trace of gold. Crosscuts at the 50 ft. level prove the body to be there 55 ft. wide, and to carry 15% copper, with 3 dwt. gold per ton. The crosscut at


Section through
Prospecting Shaft & No 1 Crosscut
Section
No 4 Crosscut, 125 ft Level
Sketch
Plan of Workings
125 FT LEVEL
MOUNT ELLIOTT
Scale - Feet
50
0
50
100
Barren Slates only slightly kaolinised
Main Drive
Monkey Shaft
Winze
Rich Kaolin ore
Kaolin on each side of main drive but 3 ft bunch of Limonite in roof & 5 ft kaolinised Slate partly replaced by oxides of Iron & Copper & by Malachite
Kaolin gradually passing into Slate
soft rich ore containing efflorescent sulphate
Dense Limonite with bunches of ore
11' Kaolin
Prospecting Shaft
Rich Limonite with Red & Black Oxides & Malachite
Somewhat kaolinised & rather ferruginous country
A few lenticular bunches of gossany Quartz
Ironstained Slates with flat veins of well crystallised Pyrite
Section
No 1 Crosscut 125 ft Level
Scale 30 feet to an inch
Greater part poor dense Limonite with stains & bunches of crystalline Malachite
Softer & richer ore containing efflorescent Sulphate
Kaolin gradually passing into kaolinised Slate
Cu 22%
Section
No 2 Crosscut & Winze, 125 ft Level
Scale 30 feet to an inch
Cu 6%
Cu 25%
Cu 23.8%
Medium grade Kaolin with Malachite
Black Oxide
with large bunches of interstitial
Cu 5.5%
Au 3 dwt
with bunches of ore
Barren Slate
Cu 10%
Kaolinised Slates with patches of Black Oxide
Slate

the 212 ft. level proves only slates, carrying iron pyrites, and is believed to be beneath and to the south-east of the north-westerly pitching ore shoot. The ore at grass is chiefly a very dense brown limonite, stained by chrysocolla and dioptase, and with thin veins of silica. Calcite is sometimes crystallised in cavities lined with drusy quartz.

The monkey shaft, also inaccessible, was sunk in hard limonite to 80 ft., where it entered the footwall limonite. The ore raised yields 16·5% copper and 1 dwt. gold per ton. The whole of the tip, some 700 tons, appears to be kaolin impregnated with malachite and gossan veined with the same mineral.

The main drive connecting the prospecting and monkey shafts at the 125 ft. level is in a body of kaolin on the footwall of the lode over the greater part of its length, but at the north-western end only barren slates, giving evidence of much lateral crushing, can be seen. It exposes in several places the footwall vein which from the prospecting shaft to the south-east is 3 to 9 in. thick, and consists of black sulphide and malachite.

The No. 1 crosscut proves 32 ft. of hard ore (dense limonite with stains and bunches of malachite) adjacent to the footwall flucan—assaying 22% copper—followed by 12 ft. of softer ore containing efflorescent sulphate.

No. 2 crosscut proves 15 ft. of hard ore (dense limonite, with very little malachite but some secondary sulphide in the softer parts), averaging 5% copper and gold nil. Beyond this to the face, cellular gossan occurs with large bunches of blue-black amorphous pulverulent sulphide (generally referred to as black oxide) in stained laminated kaolin. The first 25 ft. contains 23·8% copper and 5 dwt. gold per ton, and the remaining 10 ft., 5·5% copper and 3 dwt. of gold per ton.

The winze is sunk in slightly kaolinised slates impregnated with "black oxide," and containing occasional bunches of the same in decreasing quantities towards the bottom, where a little pyrite also occurs on the joints as yet stained by black oxide. Mr. Waller's samples are: for the uppermost 10 ft., 10% copper; the next 15 ft., 15% copper; and the remaining 35 ft., 6 to 7% copper.

No. 3 crosscut failed to find the ore body, but the iron-stained slates, with flat veins of well crystallised pyrite, are giving way in the face to more ferruginous and kaolinised country, and continuation of the crosscut may result in the discovery of at least a branch of the ore-body. The crosscut, however, must underlie the greater part of the ore shoot.

No. 4 crosscut was begun in limonite fairly rich in malachite. At 15 ft. from the main drive there is 18 in. to 2 ft. of very cellular gossan, dipping flatly to the north-east. Adjacent to this, above and below, there is 2 ft. of kaolin, with patches of malachite and tile ore; and beyond, slate to within 12 ft. of the end of the crosscut; then

3 to 5 ft. of softened slate, containing very irregular bunches of rich secondary sulphide; and this is followed by slightly stained kaolinised slates (say, 2% copper), the country in the face being very ferruginous and somewhat cellular, with very small patches of malachite. This also should be further prospected.

The western drive, when seen by me, was only 6 ft. long, in rich oxide and carbonate ore, with bunches of red jasperoid, probably averaging 20% over a width of 10 ft. It has since been proved that the ore pinches out 17 ft. from the main drive.

The footwall seam was first struck in the prospecting shaft between the kaolin and slate, at the 125-ft. level, where it consisted of black ore, 6 in. to 12 in. wide, containing 35% copper. Its average width on the 125-ft. level is 2 ft., and its composition as given above. It has been proved for 46 ft. below the 125-ft. level to average between 25 and 35% copper, and to vary between 3 in. and 15 in. in thickness, but pinching below to 1 in.

In trench (*a*), to the north-west of the crop, only kaolinised slates, with slight stains of malachite, can be seen. Mr. Waller sampled this, and found 60 ft. to average 8% copper and 10 ft. (hard ore) 20%.

In No. 2 trench, also to the north-west of the ore-body, 12 ft. of cupriferous kaolin has been exposed.

Trench (*b*) shows 5 ft. gossan and 2 ft. cupriferous kaolinised slates; and in trench (*c*) there is a formation of gossan and slightly cupriferous kaolinised slate, in which bunches of ore may be found.

Trench (*d*) shows only barren, gritty slates, but at the eastern end 6 ft. slightly gossany kaolinised rock can be seen. This becomes more gossany towards the south, and at 1 ch. from the trench is 3 ft. wide.

DETACHED ORE-BODIES.

Besides the main crop, there are several other smaller ones, any of which, on opening up, may prove to be as productive as that now being exploited. A comparatively small crop of rather siliceous quartz-bearing gossan is to be seen 2 ch. south-east of trench (*d*). Including ferruginous country, it is 20 ft. wide, and it is at least a chain long.

East of the last about 2 ch., several irregular bunches of gossan occur in silicified iron-bearing slate, which represent bunches of ore. There would seem to be no continuation of the ore-bearing zone southwards, for only a chain away from the last barren thin-bedded blue slates, dipping steeply to the north-east, are exposed in a low precipice.

Other crops of gossany ore and slate that require to be opened up lie 2 ch. south-west of the northern end of the main crop and 5 ch. south-west of the southern end.

Much gossan occurs scattered over the flat about 15 ch. north-west of the main crop. This should be prospected, as it is apparently on the line of strike of the main lode.

Some trenching ½ mile north-north-west of the mine has revealed silicate ore in speckled schist, with small patches of gossan.

ORE RESERVES.

The latest estimation of the amount of ore proven above the 125-ft. level is that by Mr. Waller: 45,000 tons averaging 16·4% copper and 2 dwt. gold per ton. This refers only to "hard ore," similar to that in the main crop, the large bodies of kaolin ores being omitted because of their irregular development and the small amount of work done on them.

As to ore below the 125-ft. level, there is every probability of the main body pitching to the north-west as first predicted by the present manager, but no work had been done to prove this at the time of my visit. The gossan has been formed from sulphides, which are to be expected below the water-level, and may contain anything from, say, 3% to 30% copper. In the neighbourhood of the water-level there ought, however, to be considerable secondary enrichment, and chalcocite and cuprite may there be found almost replacing the limonite and original sulphides.

GEOLOGY.

These ore bodies occur in an area of upturned slates and schists, presumably part of the great province of Cloncurry, which there is some reason to regard as Pre-Devonian. The separate bodies in the vicinity of the main Mount Elliott outcrop make little show above the ground, and cannot be traced for any great distance; yet there is a possibility of any of them increasing greatly in size below the surface.

In my opinion, the ore bodies do not lie on true fissures (extensive dislocations of the crust, allowing relative movements of great masses of country on opposite sides), but follow the bedding of the enclosing strata. The sulphides may have been given off from deep-seated intrusives at the time of their cooling. The bedding planes will have allowed almost as free passage as a fissure, and when precipitation has been brought about at any point from any cause deposition is likely to have been continued there by metasomatic interchange with the country rock. In this way may have been formed either a succession of leases or one long pipe (shoot), but which it is can only be proved by sinking. Crushing of the country may have been caused either by expansion during replacement, or, more likely, in oxidation of the original pyrite and chalcopyrite to limonite, when kaolinisation of the adjacent country took place.

The formation of the kaolin ores would follow the oxidation of the sulphides, kaolin exerting a powerful precipitative action* on the copper-bearing solution leaching from the main body. These rich ores are, therefore, not to be expected below water level, and instead of kaolin there will be barren or, at most, pyritous slates.

Labour Victory (R.C. 29).

LOCATION AND AREA.

The Labour Victory is located in the southern part of the Agate Downs Goldfield, 53 miles south of Cloncurry.

Its area is 40 ac.

HISTORY.

This reward claim was granted in July, 1903, and has been worked spasmodically till the present as the following historical notes show:—

July, 1903.—Reward Claim granted and ore being raised.
Jan., 1905.—Work resumed.
Mar., 1905.—Shaft 35 ft. deep; lode 4 ft. wide.
Sept., 1905.—Shaft 52 ft. deep and new shaft started.
Feb., 1907.—Syndicate formed. Total of 85 tons ore obtained.

DEVELOPMENT.

The workings include a trench 6 ft. deep and 20 ft. long at the north end, besides one or two other shallow cuts; two potholes 8 ft. and 10 ft. deep, respectively, 2 and 3 ch. south of the main shaft; an opencut, 20 ft. long and 12 ft. deep, on the southern side of the main shaft; the main shaft 47 ft. deep and 2 ch. south of the northern trench, has a stope running back for 10 ft. south, and a level at 35 ft. depth 25 ft. long with overhead stope 10 ft. high at the shaft; the new shaft 50 ft. to the north of the main shaft and 47 ft. deep; and a 12 ft. pothole adjacent to the quartz crop 15 ft. east of the last.

OUTPUT.

1903—	$7\frac{10}{20}$	tons		44%	copper	and	6	dwt.	gold	per ton.
	3	,,		35%	,,	,,	3	,,	,,	,,
	5	,,	(secds.)	22%	,,					
1904—	18	,,		30%?	,,					
1905—	13	,,		41%	,,					
	20	,,								
	35	,,								
1906—	$78\frac{10}{20}$	,,								
	180	tons		over 35%	,,					

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* Absorption. By Walter H. Weed and E. Kohler, "Engineering and Mining Journal." 23/2/'05. Also, Precipitation of Copper by Natural Silicates. By Eugene C. Sullivan. "Economic Geology." Vol. I, No. 1.

ORE-BODIES.

There appear to be at least three overlapping and nearly parallel lines here, but the only body of copper ore of any size is that at the main shaft. This may yet be proved to increase in size in depth but the present exposure warrants energetic development.

In the northern trench is an 18 in. nearly vertical body of limonite and quartz carrying bunches of ore. The strike is like that of the country rock here only slightly altered.

Half a chain south of the cut there is a crop of gossan apparently on the continuation of the above body, which has not been proved further south.

Just to the north of the new shaft is a blow, a chain long and up to 6 ft. in width, of limonite and quartzite—probably the cap of a rich siliceous pyritic lens.

The new shaft was sunk in kaolinised slates on, it is reported, a 2 ft. seam of quartz. There is only about a ton of ore at grass, consisting of a mixture of earthy black oxide and green carbonate of copper.

The 12 ft. pothole was opened on the eastern side of a quartz blow, but there is no justification for its continuation.

The main shaft shows a 5 ft. formation near the surface, but in the southern stope an average of 6 ft. has been removed between the 10 and 35 ft. levels, and even that is not the whole width of ore. In the northern face there is standing 5 ft. of slightly siliceous red ore (tile ore containing much malachite and probably assaying 35% copper) which would appear to be a rich shoot pitching northwards from the shaft, where 46½% ore was broken down. On the west of it is a foot of gossany material, and then kaolin (as on the east, where the schistose structure is discernible). The ore is poorer in the floor of the drive, and is said to have pinched below, in the shaft which was unfortunately inaccessible. The greater part of the ore shipped from the mine has come from this shaft and the opencut to the south. The firsts include an earthy black chalcocite, sometimes irregularly veined and impregnated with acicular malachite and occasionally showing scattered granules of pyrite evidently in process of replacement by the secondary sulphide. The chalcocite sometimes changes imperceptibly into limonite, in which also grains of unoxidised pyrite can be detected. When inspected the seconds at grass amounted to 70 tons, and comprised carbonate in gossan and replacing kaolinised slates, but generally free from silica and probably carrying 20% copper. The heap is made up in part of carbonate veined tile ore, and the precipitative action of clay is clearly indicated by the zone of earthy malachite surrounding fragments of clay slate in the ore. Besides this ore, the "thirds" at grass amounted to 20 tons—dense limonite, with a slight impregnation of malachite, containing between 10% and 15% copper. Some pyrite is visible in the interior of the limonite blocks raised.

In the southernmost pothole there is 12 to 18 in. of gossan dipping eastwards in green stained kaolinised slate, but only ½ ton of ore has been shipped from here.

In the pothole a chain to the north of this there is under an 18 in. to 2 ft. cap of quartz, an irregular formation up to 5 ft. in thickness, with small rich lenses of gossan and malachite in kaolin (decomposed clay slate).

A small bunch of 37% ore (1½ ton) lay 30 ft. east of the main shaft.

Fluxiana (M.L. 414).

Mgr., G. A. Waller.

LOCATION, ETC.

The Fluxiana is on Cave Mountain, near Maggie's Creek.

Its area is 20 ac. The ground held by the Mount Elliott Company for the supply of flux. It was not visited by me.

Occidental (M.L. 310).

(McEvoy and Leray.)

LOCATION, ETC.

The Occidental is near the Labour Victory.

Its area is 10 ac. It was not visited by me.

Twiggie Vous (Extended M.C. 277).

(Mgr., Bentley.)

LOCATION, ETC.

The Twiggie Vous is 5 miles north of the Labour Victory and ½ mile off the Devencourt road.

Its area is 1,200 ft. × 350 ft. It was not visited by me.

HORSE CREEK.

Horse Creek also rises on the Selwyn Range, but some miles to the west of Maggie's Creek. Its general course into the Cloncurry River is north-north-westwards.

HORSE CREEK GROUP.

In this group, which lies 50 miles south-by-west from Cloncurry, are included only the leases giving it the name, but it is understood that developments have lately taken place in the neighbourhood on Boomerang Creek. Rich specimens, consisting of chrysocolla in kaolin and of intermixed malachite and tile ore, have been brought to me from the latter locality.

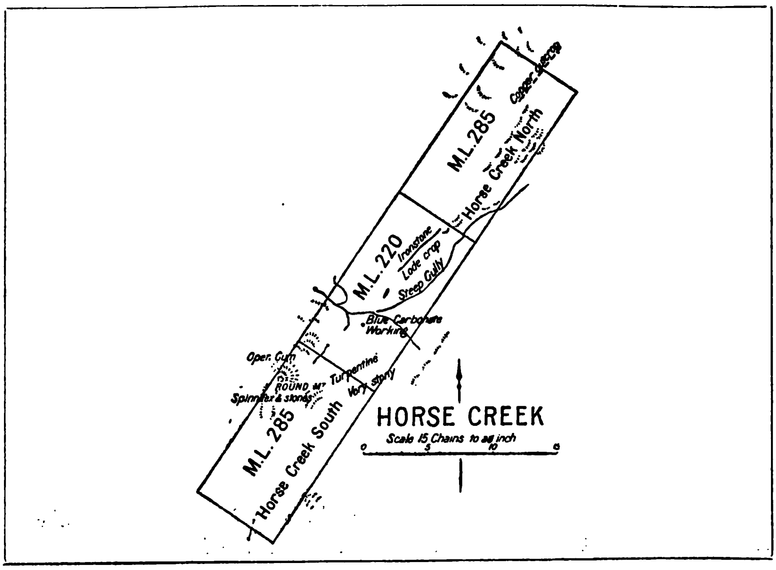
In travelling from the Duchess to Mount Elliott my route took me through Horse Creek country, the mine being missed through incorrect directions having been given me. Topographically the country shows little diversity, there being only slight and rounded rises and shallow depressions. The rocks seen were chiefly silicified slates and quartzites.

Horse Creek (M.L. 220, Etc.).

Mgr., Matheson.

LOCATION.

These leases are located on one of the head branches of Horse Creek, 50 miles south-by-west from Cloncurry, and 3 miles north-east of the south-eastern corner of Devoncourt No. 5 run block. They are about 7 miles from the Devoncourt-Hampden road, and, as work had not begun here and a guide was not available, no attempt was made by me to find them.



AREA.

The five leases here, each 10 ac. in area, are Nos. 220, 285 (1 South), 286 (1 North), 559 (2 South), and 560 (2 North). They are the property of the Mount Merlin Copper Company.

DEVELOPMENT.

The manager's reports in the Brisbane Press state that 6 men began in January of this year, to open-cut the lode at the northern end of the lease. In April a shaft had been sunk 16 ft.; an old shaft on the No. 1 South was being cleaned out, and in May the vertical shaft was 60 ft. deep.

OUTPUT.

1897— 3 tons ...	...	shipped by Brady, prospector—47½ % copper
1905—13 „ ...	...	

ORE DEPOSITS.

Mr. Brady, the prospector, informed me that veins of ore occur over a width of 60 ft. in schists. Warden Cherry has stated that the outcrop resembles that at Hampden, and the manager reported: "The main outcrop is a peculiar jumble of schists quartz and kaolin, all more or less heavily impregnated with copper carbonates and red oxide." It is shown on the surveyor's plan running north-east. In February, 1907, the manager reported that there were 70 tons of good quality ore in the paddock. In April, 1907, he reported that the face of the open cut, 10 ft. high and 16 ft. wide, was "showing good bunches of hard carbonates."

At the same time he mentioned that in the ends of an old shaft on Horse Creek No. 1 South, can be seen a 12 in. vein of high-grade ore, and in May that the ore-body to a depth of 60 ft. is quite vertical.

Unnamed (M.L.).

LOCATION.

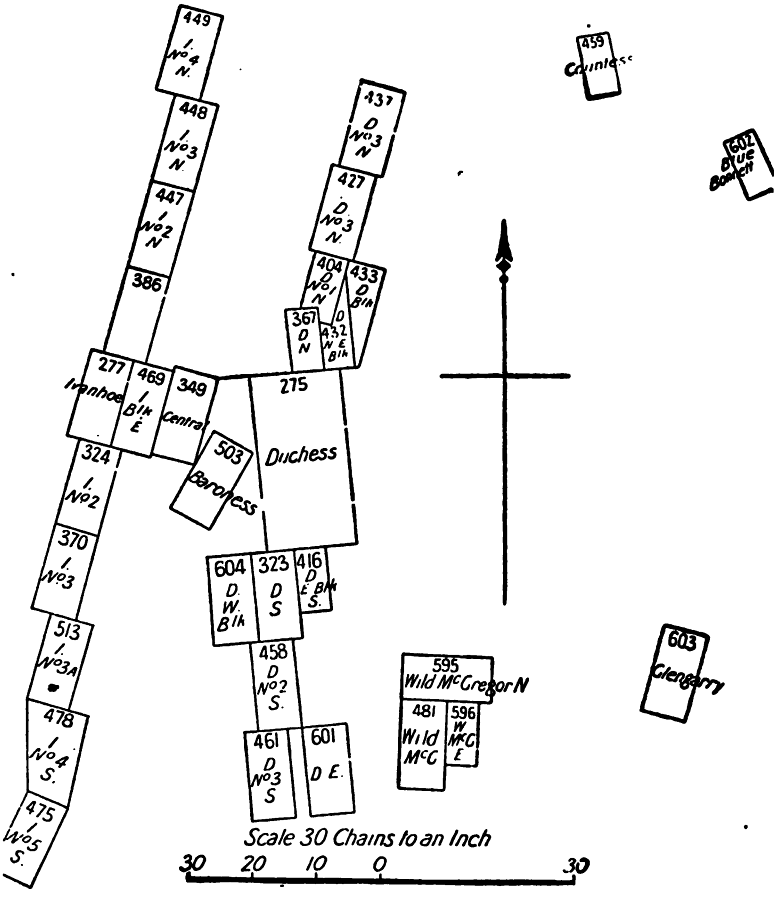
This is on Boomerang Creek, 14 miles from Devencourt.

ORE-BODIES.

Chrysocolla in kaolin and an ore consisting of intermixed malachite and tile ore (40% copper) have been shown me from here.

BURKE RIVER.

These groups, which are between 60 and 70 miles south-west of Cloncurry, comprise a large number of leases on the Duchess, Ivanhoe, Wild MacGregor, Pilgrim, and other lines. Reference will be made below only to the principal leases.



DUCHESS AND IVANHOE GROUPS.

Geologically the Burke River district has several points of similarity with the country in the immediate vicinity of Cloncurry—limestones, partially replaced by quartz and iron oxide, occurring under similar conditions in the A1 freehold and on the Ivanhoe (and Pilgrim ?) leases. The beds of indurated felspathic sandstone are, however, characteristic of the Duchess.

DUCHESS GROUP.

The Duchess Group is here made to include besides the Duchess, the Ivanhoe, Wild MacGregor, and others more usually referred to separately. Leases in force on the various lines not here described are shown on the attached plan.

Duchess (M.L. 275).

C. L. Smith—Gen. mgr.

LOCATION.

The Duchess lies on the northern bank of Jack's Creek, one of the upper branches of the Burke River, 61 miles south-west of Cloncurry. The track to the mine leaves the Cloncurry-Urandangi road at a gate 4 miles west of Devoncourt station, the total distance to Cloncurry by road being 73 miles.

It is situated in a nearly flat bottomed north and south valley, with rocky hills on either side.

AREA AND HISTORY.

M.L. 275 has an area of 40 ac., and is the property of the late owners of the Hampden Copper Mines.

In Feb. 1906 the original holders sold the lease for £15,000 to the Hampden-Cloncurry Copper Mines Limited, and since development has been steadily carried on.

LITERATURE.

For titles of reports numbered as below see Introduction.

(4) Under the description of the Pilgrim Creek Leases Mr. Cameron refers to the Duchess thus:

> *Lease No.* 54 shows an outcrop of copper ore on level ground, noticeable as a band of green stained rock of about 80 yards in length and 30 feet in width at the northern end. The ore showing on the surface is chiefly rich glance, considerably weathered to carbonate. Along the western wall the ore is associated with quartz in a vein of a foot or two in thickness, following the bedding of the country rock. The remainder of the lode appears to be an impregnation in a decomposed felspathic sandstone. Samples of the ore gave an assay 46·2 per cent. of copper, a trace of gold, and 4 oz. 12 dwt. 8 gr. of silver per ton. Further south the lode appears to pinch considerably, but is traceable by a line of small patches of quartz and carbonate for the next 30 yards. It shows here as a knob of quartz with copper glance and carbonate about 3 feet in thickness, the total width of the lode being apparently about 6 feet. Some ore picked from here assayed 47·57 per cent. of copper, a trace of gold, and 7 oz. 1 dwt. 3 gr. of silver per on. Forty-four yards further south another outcrop of quartz is seen, and again yards on, a patch, 13 yards in length by 3 feet in thickness, shows copper glance and carbonate. A sample of ore from here assayed 35·2 per cent. of copper, a trace of gold, and 6 oz. 0 dwt. 5 gr. of silver per ton. The appearance of the outcrop of this lode is very promising, and from what can be observed of the general mode of occurrence of the copper ores in the district, shows a good prospect of being able to turn out a considerable quantity of rich glance ore above the water level. A few shallow trenches and shafts would soon throw light on its probable value.

(7) Mr. Rutherford describes the outcrop, and then continues:

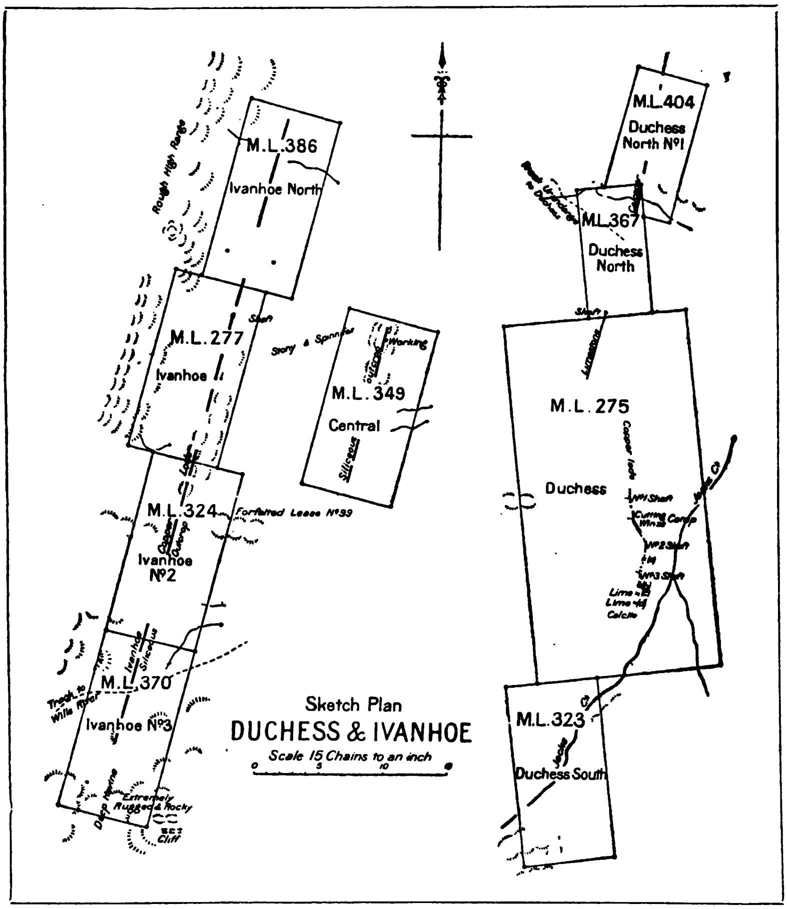
> I consider this outcrop to be a series of shallow quartz veins impregnating the bedding of the sandstone and associated in places with rich copper glance. . . .
> I feel sure that very little work will prove it to be a surface aggregation.

DEVELOPMENT.

The workings at the time of my visit were as follow:—

Four *trenches*: (a), 1 ch. south of No. 2 shaft; (b), ½ ch. south of No. 3 shaft; (c), 1 ch. south-south-west of No. 3 shaft; and (d) ¾ ch. beyond (c);

An *open cut* is, 2½ ch. long, 6 ft. wide and 12 ft. deep. The northern part is now being worked down in three benches.



Sketch Plan
DUCHESS & IVANHOE
Scale 15 Chains to an inch

A *winze*, 20 ft. deep, is near the centre of the open cut.

No. 1 shaft, the northernmost, is in about the centre of the lease a little over a chain north of the open cut. It is 55 ft. in total depth, and drives have been opened at the 45 ft. level for 40 ft. north and 60 ft. south. The drives were being extended when visited.

No. 2 shaft, 1 ch. south-south-east of the open cut, is 73 ft. deep. At 45 ft. depth a drive has been carried 15 ft. south and several feet north.

No. 3 shaft, $2\frac{1}{2}$ ch. south-south-west of No. 2, is 52 ft. in total depth, and has drives at the 45 ft. level, 60 ft. to the south, and 66 ft. to the north.

OUTPUT.

1905—$11\frac{18}{20}$ tons shipped, containing ... ... 46% copper
1906—$26\frac{17}{20}$,, ,,
500 ,, at grass ,, ... 35% ,,

GEOLOGY.

The country to the south of the workings is a pink indurated granular felspathic rock—probably once a sandstone—apparently striking north-east, though the evidence is not conclusive, it being difficult to distinguish between jointing and bedding planes, except where, as in the southernmost shaft, indistinct ripple marks are visible. In the other workings sandstone, slate, and schist alternately form the enclosing walls, and that alone points to the ore-body crossing the strata, but nevertheless there is not sufficient evidence to call this a fissure lode. It is more probably a succession of lenses on a crush zone. The dip of the ore-body is almost vertical, any underlie being to the west.

Water level is 50 ft. from the surface, and in No. 2 shaft water is making at the rate of 3,000 gall. per 24 hrs.

ORE-BODY.

It is understood that the ore originally rose several feet above the ground but the crop had been removed prior to my visit, when little could be learnt from an examination of the surface, beyond the open cut, of underlying ore-bodies.

The southernmost *trenches* (*c and d*) show nothing of the ore-body, though there is much sinter in the decomposed country and coarsely crystallised calcite crops just beyond.

In the *trench* (*b*), however, there is between 1 and 2 ft. of malachite and earthy cuprite ore.

In the *trench* (*a*) between shafts Nos. 2 and 3 is a formation 4 ft. wide, of which, however, only 6 in. is cupriferous.

In the southern part of the *open cut* the decomposed country adjacent to the ore carries much lime, and the ore-body (earthy malachite and glance) averages 3 ft. in width—4 ft. near the centre and 18 in. at the southern end—and contains 30% copper. To the south of the cut there is little ore cropping, and what there is is poor.

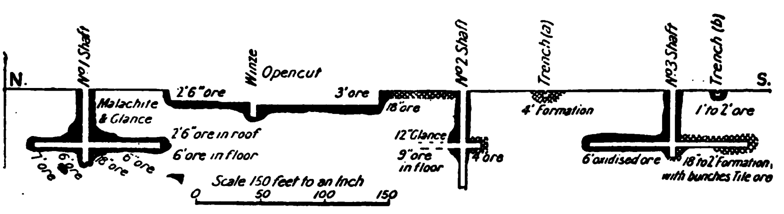
The ore bagged from the southern part of the cut, still at the mine, amounts to 150 tons.

In the face at the northern end of the open cut the ore-body (malachite, with some glance) increases in width from 18 in. at the surface to 2 ft. 6 in., 8 ft. below. The ore from the northern end of the cut, of which 100 tons is paddocked, is siliceous, containing lumps of quartz, but it will average 30% copper.

Besides this some 15 tons have been bagged, and there is over 100 tons of high grade ore in the tip. At the time of my inspection besides that bagged some 80 tons of unsorted ore, chiefly malachite and glance, lay at the cut.

The southernmost *shaft, No. 3,* has been sunk where the surface indications are not very favourable, and unfortunately no great improvement has taken place at a depth. In the southern drive on the 45 ft. level the eastern wall, dipping steeply to the west, is seen to be well slickensided. In the face the formation, only 18 in. to 2 ft. wide, consists of crushed country with quartz lenticules and bunches of tile ore stained with malachite, but nearer the shaft bunches of gossany tile ore are rather more abundant. The northern drive proved an average of 6 in. of oxidised ore (25% copper), but in the face there is 9 in. carbonate-bearing tile-ore which will probably average 30% copper, and in one place there is 2 ft. of formation, with lenticular bunches of ore and quartz. It is, however, not very well defined. The country rock is a felspathic sandstone proved for 26 ft. in the western crosscut; it has cleavages running north and south, but the bedding planes would appear from the indistinct ripple markings to be nearly north-east and south-west. The country rock east of the ore-body has a slaty appearance, but is really the same as the western. The work done in this shaft might be taken to indicate that the ore-body is on a true fissure, but on the whole it is more likely to be simply a shear zone along the master jointing.

Some ore has been bagged from here, but the seconds at grass are very siliceous.



SECTION ALONG LINE OF LODE, DUCHESS.

The *No. 2 shaft* workings reveal a somewhat more promising state of affairs. The ore is reported to be 2 ft. 6 in. wide at the shaft bottom, but the water is heavy. In the southern drive the formation, except in the face, where it pinches to 2 ft., is 4 ft. wide, but there is little copper ore in it. The country rock here is slate, the strike of which appears but indistinctly to be across the lode. In the roof of the northern drive 12 in. of rich glance ore is visible, and in the floor 9 in. The ore becomes very ferruginous in the face, but the presence of decomposing pyritic ore is indicated by abundant efflorescent epsomite. The ore-body is bounded on the east by 12 in. of quartz, the country rock being schist striking across the lode.

About 40 tons of ore lie bagged at this shaft, with 20 tons fine-grained siliceous seconds (15%) and 15 tons unsorted ore (20%)—the chief copper mineral being malachite, though much glance is also present.

No. 1 shaft shows malachite and metallic glance across its whole width at the surface and the exposures on the 45 ft. level are even better. At the shaft there is only 18 in. of ore, but a few feet north of it the body opens out to the full width of the drive, and in the face of the northern drive 7 ft. of ore is visible, while the western wall has not yet been reached. The ore is earthy malachite, with some earthy cuprite and a little dense limonite. It probably will average 35% copper, but is becoming less pure towards the west. In the southern drive the eastern wall has been considerably slickensided vertically, but the ore-body is very irregular. Halfway along the drive, where the country is schist, the ore is only 6 in. wide, and beyond it for some feet there is only poor formation; but it then gradually increases to 6 ft. Near the southern face a horse (of decomposed sandstone ?) comes in from above, and in the face the ore-body is only 2 ft. 6 in. wide in the roof, and, containing 20% silica, is much more siliceous than usual, but in the floor it is 6 ft. wide. Bunches of chalcocite, both dull and metallic (glance), occur in the oxidised ore and also in the quartzite here.

About 30 tons of ore lie bagged at this shaft, and 50 tons of firsts have been paddocked.

ORE DEVELOPED.

Owing to the extremely irregular nature of the ore-body, it is not possible in the present state of development to calculate with any pretence to accuracy the ore available above any level at the Duchess. From the data obtained in the drives on the Nos. 1, 2, and 3 shafts, a minimum of 5,000 tons may be depended on above the 45 ft. level without taking into account that the thick deposit of rich ore exposed in the open cut should also be struck by continuing the southern drive from the No. 1 shaft. Developmental work should be carried out vigorously, especially towards the north, in proving the ore at a depth and blocking it out to prove the value of the mine.

Duchess North (M.L. 367).

LOCATION, ETC.

The Duchess North adjoins the Duchess on the north.

The area is 5 ac. The ground was deserted at the time of my visit.

A shaft has been sunk near the southern boundary to a depth of 35 ft.

GEOLOGY.

The shaft is in black micaceous schist, with bunches of calcite and bands of felspathic rock (altered sedimentary probably) just to the north of a crop of granular calcite a chain long and 6 ft. wide, changing southwards into yellowish limestone, with grains of quartz scattered through it. This limestone outcrop can be traced for 6 ch. to the south-south-west of the shaft in the direction of the general strike of the country, and it is therefore not the continuation of the Duchess lode. The latter has not been exposed within 10 ch. to the south, and in the intervening space may have been faulted or have pinched out altogether.

Duchess South (M.L. 323).

LOCATION, ETC.

This adjoins M.L. 275 (Duchess) on the south-west.

Its area is 10 ac.

It was understood that no work had been carried out on this lease, and it was therefore not inspected.

Ivanhoe (M.L. 277).

Mgr., Peberdy.

LOCATION, ETC.

The Ivanhoe lies ¼ mile west of the Duchess, on Burke River waters, 61 miles south-west of Cloncurry.

The area is 10 ac. This is the property of the Leichhardt-Cloncurry Development Syndicate.

LITERATURE.

For titles of reports numbered as below see Introduction.

(4) Mr. Cameron wrote:

> *Lease No.* 99 shows an outcrop of earthy ferruginous and cupriferous ore, associated with quartz, occurring along the bedding of altered sandstones and greywackes over a distance of about 70 yards, and over a breadth of perhaps 5 or 6 feet. Some portions look as if they might open up well, but no distinct outcrop of a lode can be observed.

(7) Mr. Rutherford states:

> "The copper staining is confined to patches of limestone and to some prominent boulders of jasper. The property seems to me of little promise."

(12) Mr. Waller considers the Ivanhoe a lode, and says that—

> "Concentration of copper ore may be reasonably expected underneath the capping at and below the permanent water level. The prospects of discovering rich deposits are greatly strengthened by the success which has been attained at the Duchess Mine."

DEVELOPMENT.

At the time of my visit only a few potholes had been sunk, but preparations were being carried out to begin the sinking of a deep shaft near the northern end of the lease.

GEOLOGY.

There is here a pronounced crop, 12 ft. in greatest width and 4 ch. in length, of silicified limonite, in which can be seen some pure quartz and occasional bunches of poor copper ore. The latter consists of carbonates and reddish oxides (20% copper), and the largest bunch seen contained only a ton or two at most. The crop has a considerable extension, but owing to the limited time available and the absence of workings, the necessity to traverse much of it was not apparent. The crop agrees with the strike of the country, and in all probability represents a bed of impure limestone in which the calcium carbonate has been replaced by iron oxides and silica, and as such it is not expected to prove a great copper producer.

Wild McGregor (M.L. 481).

LOCATION, ETC.

The Wild MacGregor is 25 ch. south of the Duchess, which is 61 miles south-west of Cloncurry. The road to Devoncourt and Cloncurry crosses this lease.

The area is 10 ac.

The main shaft is 30 ft. deep, and there are besides several other insignificant openings.

GEOLOGY.

There is no defined outcrop here, the ore presumably occurring as bunches in decomposed slate. The ore bagged amounts to 5 tons.

Maude A. (M.L. 360).

Mgr., Alexander.

LOCATION, ETC.

The lease is 1½ mile south-south-east of the Duchess South, and 3 ch. north of the Burke Rabbit Board's fence.

The area is 3 ac. This lease was not inspected.

A shaft and a cut are shown on the surveyor's plan.

OUTPUT.

1906—$7\frac{19}{20}$ tons shipped.

ORE-BODY.

The crop is shown on the surveyor's plan striking east-south-east.

Revenue (M.L. 379).

LOCATION, ETC.

The Revenue is 5 miles north-north-west of the Duchess North No. 1.

The area is 5 ac. This lease was not inspected.

The surveyor's plan shows two shafts and other workings.

ORE-BODY.

The strike of the ore-body according to the surveyor's plan is north by west.

PILGRIM GROUP.

This group was not visited, as it was understood that no work was going on.

Pilgrim (M.L. 276).

Mgr., Kennedy.

LOCATION AND AREA.

The Pilgrim is 3 miles south-west of the Duchess.

The area is 10 ac. This is part of forfeited leases Nos. 55 and 98.

LITERATURE.

For titles of reports numbered as below see Introduction.

(4) Mr. Cameron's full report is as follows:—

Lease No. 98.—Indications of copper are found on this lease along a belt of limestone running north and south through the lease along its western boundary. The limestone belt, which has narrow bands of interbedded schists, is from 60 feet to 100 feet in breadth. It is coarse-grained, and has a distinct schistose structure, the calcite grains lying with their shorter axis at right angles to the stratification. Along this belt of limestone occur several prominent outcrops of a siliceous rock similar to that found in the Cloncurry and Hampden Lodes. They are as much as 10 to 20 feet across and up to 20 feet in height. They are not apparently ore-bearing. On the south-western side of the southernmost of these, however, a little glance and carbonate ore is exposed; but it is almost entirely covered with soil, and its extent cannot even be guessed at. About 20 chains from the north end of the lease on the line of the siliceous outcrops is an outcrop of copper ore—glance and carbonate—apparently about 20 feet through. A sample from here assayed 27·1 per cent. of copper, a trace of gold, and 6 oz. 15 dwt. 22 gr. of silver per ton. This outcrop is well worth systematic prospecting. Its continuation is obscured by surface accumulations and it is possibly rich for some distance further north.

Lease No. 55.—The copper indications on this lease occur in a steeply-inclined bed of limestone some 30 feet in width, and outcropping for a distance of about 70 yards, in places to a height of 10 feet above the ground. The copper occurs as little blebs of carbonate scattered throughout the limestone. A sample taken from across the most likely-looking portion of the outcrop gave 3·8 per cent. of copper. This is, if anything, probably a little higher than the average, as in chipping off pieces for a bulk assay it is difficult to avoid turning one's attention more particularly to points where ore occurs.

Further to the south the limestone has apparently been replaced by quartz in a line continuous with its outcrop. The quartz can be traced for about 30 feet, and is copper-bearing for about 3 feet in width. The ore is glance and tile ore, and two assays of ore picked from the surface gave 14·5 per cent. of copper and 26·125 per cent. of copper respectively. This lode shows every appearance of being worth opening up over this latter portion.

Mr. Rutherford speaks of:

A siliceous limestone belt which is impregnated with copper carbonate, the result of decomposition of glance, which occurs in pisolitic form in the rock. Beyond the limestone to the south are contorted hills of weathered sandstone showing bedding places and stained with copper in places. It was probably from this overlying rock that the copper in the limestone was derived.

Pilgrim Extended (M.L. 485).

Mgr., Kennedy.

LOCATION, ETC.

This adjoins the Pilgrim.

Its area is 30 ac.

Empress (M.L. 610).

Mgr., Need.

LOCATION, ETC.

The Empress is understood to adjoin the Pilgrim.

Its area is 10 ac.

TRIKELANA GROUP.

Very little had been heard of the Trikelana at the time of my visit to the southern part of the field, and the group was therefore missed—unfortunately, to judge by latest accounts.

Trikelana (M.L. No. 522).

LOCATION AND AREA.

The Trikelana lies on Pilgrim Creek waters, 9 miles south of the Duchess, which is 61 miles south-west of Cloncurry.

The area is 10 ac. This lease was not inspected.

DEVELOPMENT.

A shaft had been sunk 39 ft. in Oct., 1906. It is understood that an open cut, 87 ft. long, 10 ft. wide and 6 ft. deep, has now been opened.

OUTPUT.

1906 ... 6 tons shipped.

It is reported that the open cut produced:

30 tons of	... ...	25 % ore, and
100 ,,	... ...	16 % ore.

ORE-BODY.

The deposit made little or no outcrop at the surface, its presence being indicated by floaters of ore. Two specimens from the mine were given me by Mr. Allis, the owner. One contains much free quartz and kaolin, and is evidently from near the surface, being formed in great part of limonite, with stains and veins of malachite and chrysocolla—contents 10% copper. The other shows chalcopyrite in process of alteration into limonite and glance, and stained externally to some extent by malachite; this is representative of the 25% ore.

Inheritance (M.L. 657).

Mgr., Allis.

LOCATION, ETC.

The Inheritance is located north-east of the Trikelana.

Its area is 20 ac.

Legacy (M.L. 658).

Mgr., Allis.

LOCATION, ETC.

The Legacy lies north-west of the Trikelana.

Its area is 10 ac.

MOUNT BIRNIE GROUP.

The group lies 74½ miles south-south-west of Cloncurry. It was not visited as practically nothing had been heard of it at the end of last year.

Mount Birnie (M.L. 686, Etc.).

Mgr., McLeod.

The Mount Birnie leases lie within ½ mile to the west of Mount Birnie itself. They are connected by road both with Cloncurry and with Boulia.

AREA.

Mineral leases Nos. 686, 742 (No. 2), 743 (No. 3), and 744 (No. 4), are each 10 ac. in area. Three other 10 ac. leases, and one of 15 ac. have been taken up round these.

DEVELOPMENT.

Mr. McLeod has shown me a plan of the workings, complete to June, 1907. This shows, on M.L. 686, a trench 20 ft. long and 10 ft. deep, and four shafts—No. 1, 50 ft. deep, with a 15-ft. crosscut to the east at 45 ft. depth; No. 2, 15 ft. deep; No. 3, 10 ft. deep; and No. 4, 6 ft. deep. On the lease to the west two shallow shafts have been sunk; on that to the south-east is another; and on the eastermost lease is another.

ORE-BODIES.

The main ore-body on M.L. 686 is believed to strike north by east. The trench on it is understood to be wholly in ore-bearing country, there being a cupriferous and ferruginous blow to the north, 15 ft. wide, rich in cuprite over a width of 4 ft. The main shaft on the western side of the blow was sunk to water level (about 65 ft. below the surface). Numerous assays, showing high copper content, have been made of material from the shaft, but most of the specimens were probably taken from rich seams of ore. No. 2 shaft on the main line of strike has also yielded rich stone, including dense glance stained by malachite. At least six other outcrops, running in various directions, have been located on the leases.

Monastery (M.L. 467).

LOCATION AND AREA.

The Monastery lies 5 miles west of the Mount Birnie and 18 miles south of the Duchess, which is 61 miles south-west of Cloncurry.

The area is 10 ac. This lease was not visited.

DEVELOPMENT.

Open cuts are said to be almost continuous over a length of 150 ft., the most northerly being 9 ft. long, 4 ft. wide, and 12 ft. deep.

OUTPUT.

1906	6 tons shipped.	
... ...	6 ,, ,,	containing 30% copper.

ORE.

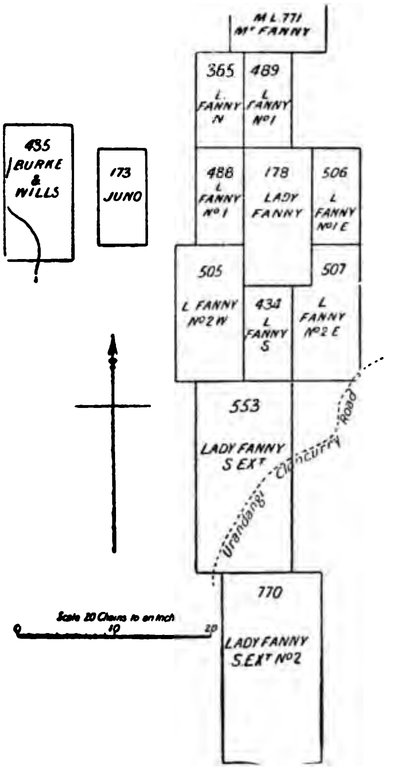
The ore is glance and malachite uniformly high in grade, and it was reported that 50 tons of 20% ore were paddocked early in the year.

WILLS RIVER.

The Mount Hope Group is included under this heading, because of the usual practice, but the mines are really within the Burke River catchment area.

LADY FANNY GROUP.

The Lady Fanny group, which is 60 miles south-west of Cloncurry, comprises, besides a number of leases adjacent to the original, the Italian, Prodigal, Blue Spec, Chum Victoria, Burke and Wills, etc.



LADY FANNY GROUP.

The Lady Fanny porphyries are similar to, but in much greater bulk than, those at the Dobbyn-Boundary Group. The association of copper ores, especially chalcocite, and porphyries is to be noted in connection with the discoveries at Ely, Nev., where immense bodies of ore containing 2 to 2½% copper are to be worked in the near future.

Lady Fanny (M.L. 178).

LOCATION.

The Lady Fanny is located near the head of a small tributary of the Wills River a quarter of a mile west of the main Urandangi road at a point 60 miles south-west of Cloncurry, and 4½ miles north-east of Teddington Lock station, on the Wills River. The distance by road from Cloncurry, taking the New Bridgewater short cut, is 77 miles.

AREA.

The area is 10 ac.

It is reported that a Melbourne syndicate had secured a 6 months' option in January last, but at the time of my inspection there was no one on the ground.

DEVELOPMENT.

The workings comprise three trenches; one shallow hole, and two shafts.

Two of the trenches are on the southern end of the main outcrop, the third on a separate crop two chains to the west. The shallow hole is on the eastern side of the main outcrop.

The old gold shaft was sunk in 1900, and is reported to be 60 ft. deep.

The new shaft, 50 ft. west of the main crop, is 103 ft. deep. It was inaccessible to me, but it is known that at the 100 ft. level there are crosscuts east and west, their total length being 100 ft.

OUTPUT.

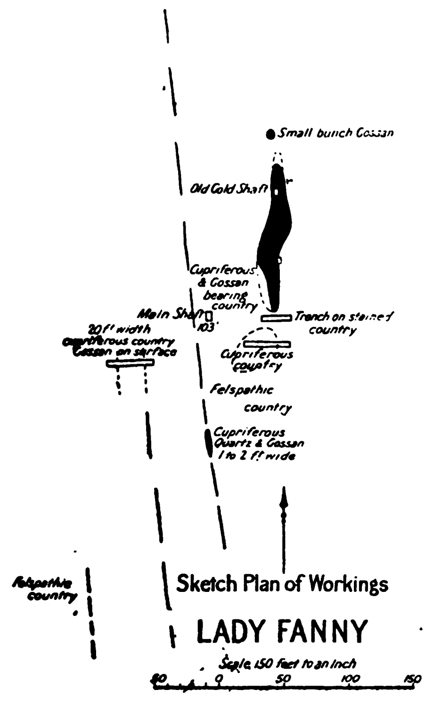
1905	...	10 tons.
1906	...	20$\frac{13}{20}$ tons shipped, containing 27% copper.

GEOLOGY.

This is an area of schistose slate and porphyry in alternate belts. The slates, over wide areas, have been rendered cupriferous, the copper minerals occurring as impregnations veins and bunches. A feature of the separate bunches on the northern part is that their general run is slightly east of north, while the cupriferous belt, as a whole, strikes slightly west of north. Only one body of any considerable size reaches the surface, and the limits of that have not been tested. The cupriferous belts are well worthy of prospecting by crosscutting, preferably from underlie shafts in the more gossany outcrops.

ORE-BODIES.

The main crop stands 10 ft. above the general level of the ground, averages 10 ft. in width (the central part is 15 ft. wide), and is 2 ch. in length. It consists of gossan, most of it carrying malachite and tile ore and some gold; that at the southern end however is cellular and, as to be expected, then carries no copper, it having been leached downwards. The body tapers out northwards, and, beyond the one small patch of gossan 5 ft. in diameter, makes no further show on the surface. It ends more abruptly on the south, the trench there exposing only slightly stained country. Just beyond this, however, the country over a width of 30 ft. is veined with green carbonate, and carries bunches of gossan, but there is no further sign of a massive ore body. The gossan would therefore seem to be the outcrop of a big bunch or shoot.


Small bunch Gossan
Old Gold Shaft
Cupriferous & Gossan bearing country
Main Shaft
103'
Trench on stained country
20 ft width cupriferous country Gossan on surface
Cupriferous country
Felspathic country
Cupriferous Quartz & Gossan 1 to 2 ft wide
Felspathic country
Scale 150 feet to an inch
50
0
50
100
150

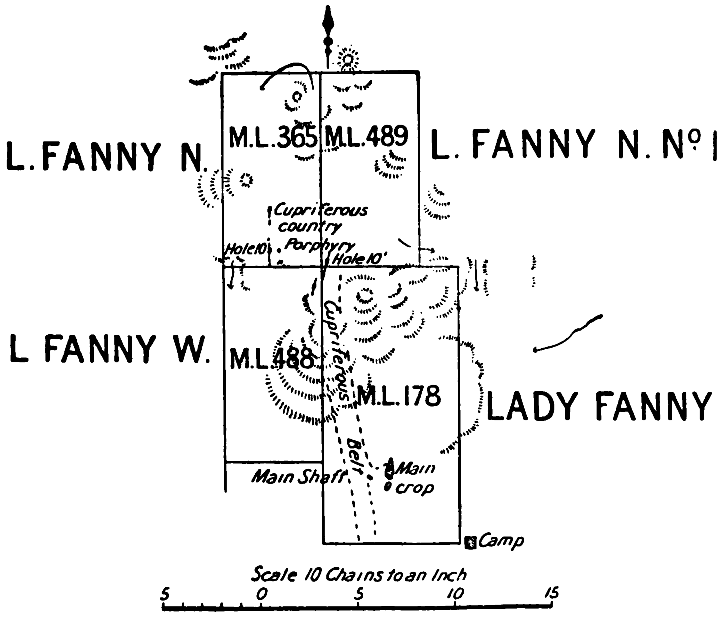
Sketch Plan of Workings

LADY FANNY

The hole sunk on the eastern side shows the ore to be not well defined from the kaolinised country to the east, into which irregular bunches project. About 17 tons of ore, assaying 27·75% copper, have been shipped from this hole. The 10 tons of ore at grass, consisting of gossan with malachite and tile ore, will probably run 20% copper.

The old shaft was sunk for gold, specks of which could be seen in the ore, but the highest yield reported was only 13 dwt. per ton. The material of the tip comprises soft gossan. This shows no copper, but copper will most certainly be found beneath it, and the shaft should therefore be deepened.

The main shaft, sunk to test the ore at a depth, instead of being in the ore-body—underlying if necessary—is in the hanging-wall country to the south-west. Very encouraging reports appeared while the work of sinking and cross cutting was in progress; sulphides were first met at 65 ft. depth, and at the shaft bottom the body was said to be 12 ft. wide and to assay, with that in the shaft, 25% copper: but there is no evidence of any quantity of ore having been raised from the shaft. The rock on the tip is bluish chloritic schistose slate, in which chalcopyrite occasionally occurs disseminated and more often as veins. Interesting changes have taken place in the country rock where it has become impregnated with chalcopyrite, the chief of which has been the production of crystalline hornblende. This occurrence is perhaps analagous to that at Rossland, B.C.,* where the deposits are considered to have been formed under dynamic metamorphic conditions. The amount of cupriferous country visible is only a few tons, but there may be more buried in the tip. The surface indications—the trench shows only stained country—are not favourable for success in cross cutting at this particular spot, but veins of chalcopyrite do seem to have been cut, and now these might be followed to the north to strike the main ore-body.



PART OF LADY FANNY CUPRIFEROUS BELT.

Just to the west of the main shaft is a belt of copper-bearing country, 2 ch. in width, which can be traced over a distance of 10 ch. A trench on the belt 1 ch. south-west of the main shaft exposes a width of 20 ft. of copper-bearing country seamed with gossan, and,

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* Metasomatic Processes in Fissure Veins. By Waldemar Lindgren. Am. Inst. M., Eng., Washington, 1900.

4 ch. south of the main shaft, there is a crop of quartz and gossan probably 2 ft. wide, on which, however, no work has been done. The southern part of the belt is well worth a thorough prospecting; but, in the north western corner of the lease, conditions for the development of large bodies do not appear to have been so favourable, the ore bunches being comparatively small and the intervening country exceedingly hard and undecomposed. Though a few tons may be got from the surface, this part of the belt is not likely to be ever mined as a whole.

Lady Fanny North (M.L. 365).

Location and Area.

This lease lies north-west of the Lady Fanny, adjoining it only at the south-eastern corner.

The area is 5 ac. The lease was unmanned when seen by me.

Development.

The workings, which are at the southern end of the lease, 90 ft. above the Lady Fanny brace, comprise two potholes 2 ch. apart, one of which, the southern, is 10 ft. square and 10 ft. deep.

Output.

4 tons shipped containing ... ... 20% to 30% copper.
1906 5½ „

Ore-bodies.

At the northern hole only copper-bearing country rock is visible, but at the southern hole can be seen 9 in. of gossany material on the west and 18 in. of similar stuff on the east of 8 ft. of kaolinised porphyry. The ore can be traced on the surface for ½ ch. north of the big hole and 1 ch. south, where there is 3 ft. width of gossany country and quartz containing say 10% copper.

The seconds at grass, about 5 tons weight, consist of blue and green carbonate in siliceous gossan, and contain 10% copper.

Geology.

These bodies probably simply fill cracks of limited extent. The country is hard schistose porphyry, and though the separate bodies give no sign of permanance the possibility of the porphyries being uniformly cupriferous at a depth is not to be overlooked.

Lady Fanny North No. 1 (M.L. 489).

Location, Etc.

This adjoins the Lady Fanny on the north.

The area is 5 ac. The mine was idle when inspected in January.

Only one hole, 10 ft., has been opened, and that is in the south-western corner.

Ore-body.

The ore-body can be traced southwards for nearly a chain into the Lady Fanny. In the hole it is 2 ft. 6 in. wide—the usual oxidised gossany ore, rather siliceous but containing at least 20% copper. The felspathic country rock is much kaolinised, and, as in the Lady Fanny North, may prove evenly cupriferous at a depth.

Unnamed (M.C.).

LOCATION, ETC.

This lies 1 m. north of the Lady Fanny. It was not visited by me.

There is a 10-ft. open cut (May, 1907).

ORE-BODIES.

There is reported to be a formation, 1 to 2 ft. wide, of copper ore (oxidising pyrite) and crystalline hæmatite. Gold occurs in paint and sheet form on the faces of the crystals of hæmatite, having probably been leached from the adjacent copper ore and reprecipitated there.

Lady Fanny West (M.L. 488).

LOCATION, ETC.

This adjoins the Lady Fanny on the west.

The area is 5 ac. The lease was idle at time of visit in January of this year.

The only opening is in the north-eastern corner of the lease; it is 10 ft. deep.

ORE-BODY.

The hole is on a body 9 to 18 in. wide of malachite-bearing tile ore in felspathic country, kaolinised near the lode. The ore cuts out a few feet south of the hole, but shows for half a chain to the north-east, in which direction it becomes very siliceous. No large amount of ore is likely to be found here.

Juno (M.L. 773).

LOCATION.

The Juno is 10 ch. west of the Lady Fanny.

Its area is 5 ac. Not visited.

Burke and Wills (M.L. 435).

Kennedy.

LOCATION.

The Burke and Wills lies 18 ch. west of the Lady Fanny.

Its area is 10 ac. Not visited

Italian (M.L. 689).

LOCATION, ETC.

The Italian lies just west of the main Urandangi road, one mile south-south-west of the Lady Fanny.

The area is 5 ac. The mine was deserted when inspected, and had been idle for months.

DEVELOPMENT.

The workings, all within a very small area, comprise an open cut and four shafts, sunk early in 1906. The open cut is 20 ft. long, 6 ft. wide, and 12 ft. deep. An underlie shaft, sunk in the middle of the cut, is 15 ft. deep. A vertical shaft, 10 ft. to the east of the shaft in the cut, is 15 ft. deep, and the other, 10 ft. to the south of it, is 46 ft. deep (inaccessible). The fourth shaft, which is shallow, lies 10 ft. east of the second.

OUTPUT.

1906 ... ... $37\frac{15}{20}$ tons shipped.

ORE-BODY.

The formation in the open cut averages 5 to 6 ft. in width. It consists of calcareous kaolinised rock stained with malachite throughout and containing bunches of gossan, with veins of acicular malachite and patches of tile ore. The ore-body was reported to be 3 ft. wide in the cut and 18 in. wide in the central shaft. The body probably does not extend beyond the limits of the open cut, but the alluvium of the flat precludes certainty on that point.

The firsts (30% copper) at grass amount to 2 tons, and consist of quartz-bearing limonite, with chalcopyrite altering into glance and veined by radiating malachite. The seconds, about 10 tons, consist of gossan with malachite, and probably will run 15% copper.

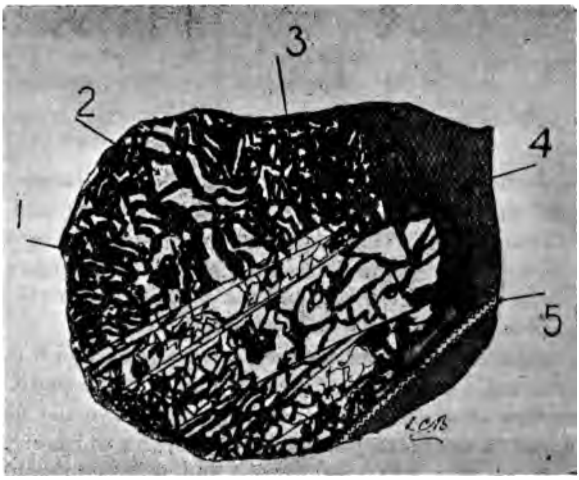


FIG. 2 (DOUBLE NATURAL SIZE).—CHALCOPYRITE ALTERING INTO CHALCOCITE AND LIMONITE, ITALIAN.

1. Chalcocite. *4. Limonite, with very little chalcocite.*
2. Unaltered chalcopyrite. *5. Malachite (vein).*
3. Chalcocite, with a little unaltered chalcopyrite.

The country rock, where visible north, south, and west, is porphyry, but to the east there is schist.

The southern shaft is in softened chloritic schist, and some glance and earthy secondary sulphide ore containing native copper has been raised from it.

Blue Spec (M.L. 368).

Gairns.

LOCATION, ETC.

The Blue Spec is 1¼ mile south-south-east of the Italian.

Its area is 5 ac. Not visited.

ORE-BODY.

The survey plan shows an outcrop striking north-west and south-east.

Blue Light (M.L. 703).

LOCATION, ETC.

The Blue Light is ½ mile north of Blue Spec

Its area is 5 ac. Not visited.

Lady Don (M.L. 702).

LOCATION, ETC.

The Lady Don is ¼ m. west of Blue Spec.

Its area is 10 ac. Not visited.

Prodigal (M.L. 490).

Mgr., Riordan.

LOCATION, ETC.

The Prodigal lies 2½ miles south-south-east of the Lady Fanny.

The area is 5 ac.

There is one shaft 35 ft. deep, and an open cut running 12 ft. south of the shaft.

OUTPUT.

1906—16 tons shipped, containing ... ... 23% copper.

ORE-BODIES.

The ore here forms a very irregular body between porphyry, which, near the lode, has been rendered micaceous, and quartzite cropping to the north. The gossan cap, very siliceous in places, can be followed for 1 ch., to the north-west (beyond which there are occasional trace of copper for 2 ch.) and for 1 ch. to the north-north-east (the indications beyond being to the east-north-east).

The formation in the shaft varies between 1 ft. and 6 ft. in thickness. It has not defined walls, but dips 1 in 3 to the south. The ore masses are very irregular in form, and half way down the shaft almost disappear, but in the bottom ore is exposed over a width of 4 ft.

The ore at grass (10 tons bagged and 9 tons broken) is dense limonite with grains of quartz (silica at least 25%) and disseminations and veins of malachite and tile ore; but, though glance is reported to be found occasionally, none was seen. This should yield 25% copper.

Chum Victoria (M.L. 690).

LOCATION, ETC.

This lease is about 1 m. north of the Lady Fanny.

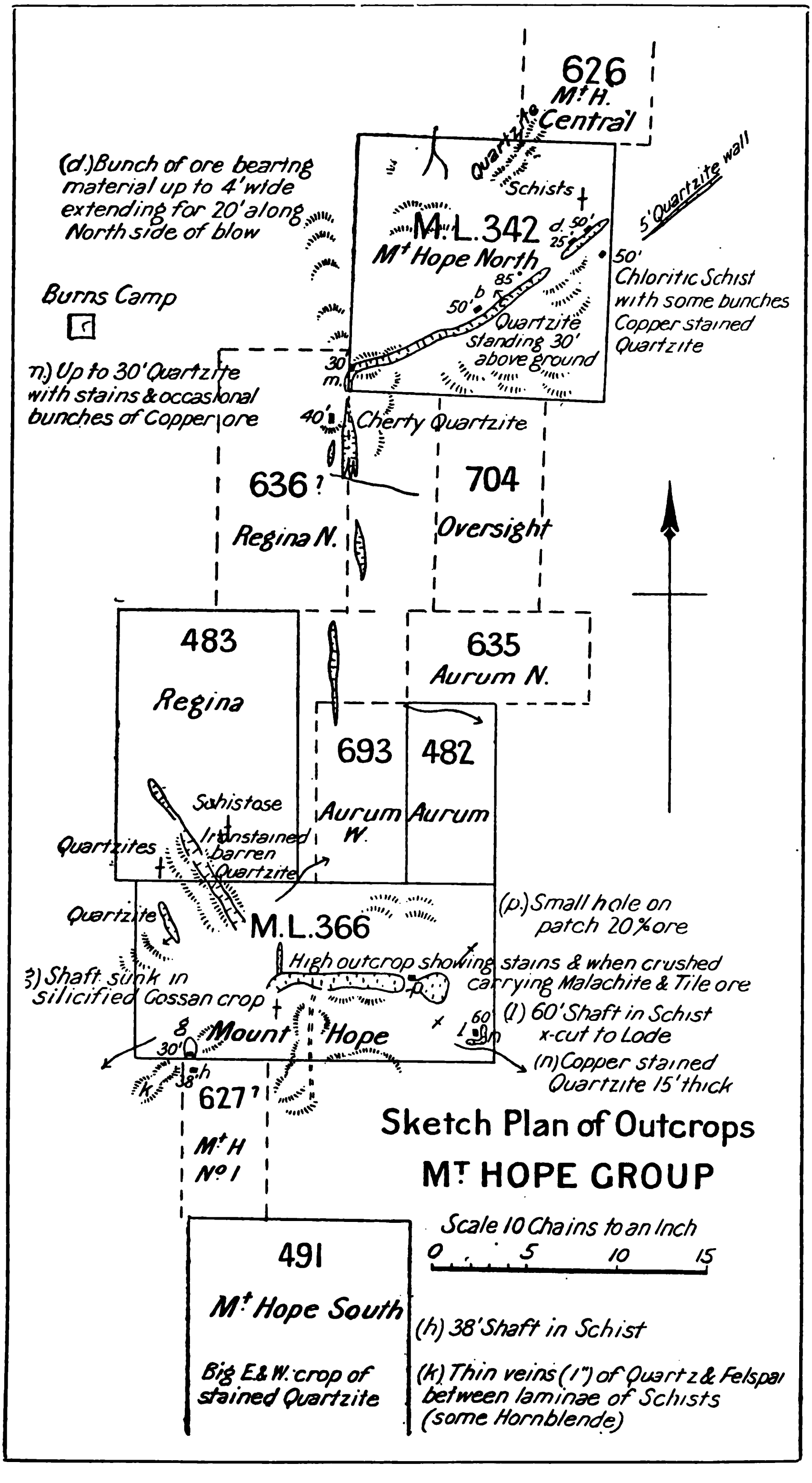
The area is 20 ac. The lease is under option to the Mount Hope Co. (May, 1907). It was not inspected by me.

ORE-BODIES.

There are reported to be here similar occurrences to those at the Lady Fanny and to be opening up well (May, 1907).

MOUNT HOPE GROUPS.

The group proper, 53½ miles south-west of Cloncurry, comprises only the Mount Hope, Regina, Aurum, and numbers, but the Little Beauty and others in the vicinity are included here for convenience.



Sketch Plan of Outcrops
MT HOPE GROUP

Scale 10 Chains to an Inch

626
Mt H. Central
Quartzite
Schists
M.L.342
Mt Hope North
d. 50' 25'
5' Quartzite wall
50' Chloritic Schist with some bunches Copper stained Quartzite
85°
b
50'
Quartzite standing 30' above ground
(d) Bunch of ore bearing material up to 4' wide extending for 20' along North side of blow
Burns Camp
(m) Up to 30' Quartzite with stains & occasional bunches of Copper ore
30' m.
40'
Cherty Quartzite
636 ?
Regina N.
704
Oversight
483
Regina
635
Aurum N.
693
Aurum W.
482
Aurum
Schistose
Ironstained barren Quartzite
Quartzites
Quartzite
M.L.366
High outcrop showing
(p) Small hole on patch 20% ore stains & when crushed carrying Malachite & Tile ore
(g) Shaft sunk in silicified Gossan crop
g
Mount Hope
30'
60
l
(l) 60' Shaft in Schist x-cut to Lode
(n) Copper stained Quartzite 15' thick
k
38'
h
627 ?
Mt H No 1
491
Mt Hope South
Big E & W. crop of stained Quartzite
0
5
10
15
(h) 38' Shaft in Schist
(k) Thin veins (1") of Quartz & Felspar between laminae of Schists (some Hornblende)

The immense quartz blows of Mount Hope are not quite duplicated in any other part of the field, and the locality is also distinguished by the presence of aplite dykes or veins, evidence of expiring deep-seated igneous activities.

Mount Hope (M.L. 366).

Mgr., Pasley.

LOCATION, ETC.

Mount Hope is located on one of the head branches of Green's Creek, a tributary of the Burke River, 53½ miles south-west of Cloncurry.

The area is 20 ac. This lease was deserted when inspected.

DEVELOPMENT.

The workings comprise two inaccessible shafts and a pothole. One of the shafts, 30 ft. deep, is on the southern boundary near the south-western corner of the lease; the other, 60 ft. deep, is in the south-eastern corner, and from it a crosscut runs south. The state of the workings did not allow of my making an underground inspection.

OUTPUT.

1906 ... ... $10\frac{18}{20}$ tons shipped.

ORE-BODIES.

Very little copper ore can be seen at the surface in this lease, but there are five prominent quartz and quartzite outcrops.

One, quite barren, in the north-western corner, is three chains long and several feet wide. It strikes north-west, dipping to the south-west across country striking north and south.

The second crop, 4 ch. to the east, is a prominent wall of barren quartzite, 10 ch. in total length, coming in from the north-west.

The third is a narrow but well marked body of quartz, 2½ ch. long, striking north and south with the country.

The fourth and main outcrop, into which the last merges, strikes east and west through the north and south striking country. It is 10 ch. in length, averages 15 ft. in width, and stands 10 ft. above the general level of the ridge. At the eastern end it bulges out to over 30 ft. in width. The silica has metasomatically replaced the country rock, and deposition has taken place since the production of north and south schistosity, which can be distinguished in places in the quartzite. Malachite and cuprite occur in the more crushed parts, but distinctly most abundantly where certain strata abut against it. The ore is seldom richer than 10%, and there is no large quantity even as rich as that. The crop, as a whole, is richer at the eastern wider end, on the northern side of which a shallow hole has been excavated on a small patch of 20% ore, consisting of malachite, cuprite, and limonite, in quartzite.

The fifth is a bow-shaped crop of copper-stained quartzite, 15 ft. thick. The 60 ft. shaft, just to the north, was sunk to test the body at a depth. The rock on the tip is dark chloritic schist, some of it stained by copper carbonate, but though good ore was said to have been obtained, little can be seen on the surface. The strike of the country is here north-east.

Another more promising crop of silicified gossan, 40 ft. in length and 15 ft. wide, is to be seen in the south-western corner of the lease, where the 30 ft. shaft has been sunk. The ore from the shaft bottom —dense gossan with carbonate stains—is not unpromising, but the greater part of the sinking was in very siliceous ore, and much of the tip is ironstained quartzite. About 15 tons of 5% ore have been paddocked.

GEOLOGY.

The occurrence of pegmatite—quartz and orthoclase (exhibiting a strong parting and a slight schiller structure), with occasional hornblende—as thin veins between the laminæ of the schists at the south-western corner of the lease, as well as over much of the country to the north-east, is interesting and important in considering the genesis of the quartz bodies. Pegmatites are the after result of igneous intrusion, the minerals having been given off pneumatolitically from the cooling magma, and it has been shown* in other parts of the world that pegmatites shade insensibly into quartz veins carrying copper minerals. It is therefore extremely probable that the Mount Hope quartzites are of deep seated origin.

Mount Hope North (M.L. 342).

LOCATION, ETC.

The lease is situated ½ mile north of the Mount Hope lease.

The area is 20 ac. This ground was deserted in January, but Mr. Burns, manager of the adjoining lease, conducted me over it.

DEVELOPMENT.

The prospecting of this lease was done during 1905 and 1906 by the Hampden Company, who, when holding an option over the property, sank 5 shafts. No. 1 shaft, in the south-western corner, is 30 ft. deep; No. 2 shaft, 8 ch. to the north-east, is 50 ft. deep; No. 3 shaft, 6½ ch. north-east of No. 2, is 25 ft. deep; No. 4 shaft, 1 ch. beyond No. 3, is 50 ft. deep; and No. 5 shaft, 1½ ch. south-east of No. 4 and adjacent to the eastern boundary, is 50 ft. deep, and has drives 50 ft. to the south and 50 ft. to the north.

OUTPUT. (Warden's reports.)

Dec., '05—20 tons raised	40% copper
Mar., '06—40 ,, ...	?
May, '06— 5 ,, bagged.	

ORE-BODY.

The outcrop tested by four of the above shafts strikes north-east-by-east across the lease from the south-western corner, where it makes a sharp bend and runs south. It consists of dense white quartzite up to 30 ft. thick, and standing in places 30 ft. above the ground. The quartzite carries only traces of copper, the stains being mostly on the surface.

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* The Rôle of the Igneous Rocks in the Formation of Veins. By J. F. Kemp. Am. Inst. Min. Eng., Richmond meeting, Feb., '01.

In shaft No. 1, on the western side of the crop, no ore was found, though a few yards to the south the quartzite carries stains and occasional bunches of ferruginous ore over a width of 30 ft.

Shaft No. 2 is on the hanging-wall side of the quartzite, and nothing more than stains of malachite in ferruginous quartzite was found.

At shaft No. 3 a bunch of ore-bearing material, up to 4 ft. wide, extends along the northern face of the quartzite for 30 ft., but only ironstained quartzite seems to have been raised. These workings have thus proved nothing of value, and there is no surface indication of any quantity of copper ore here.

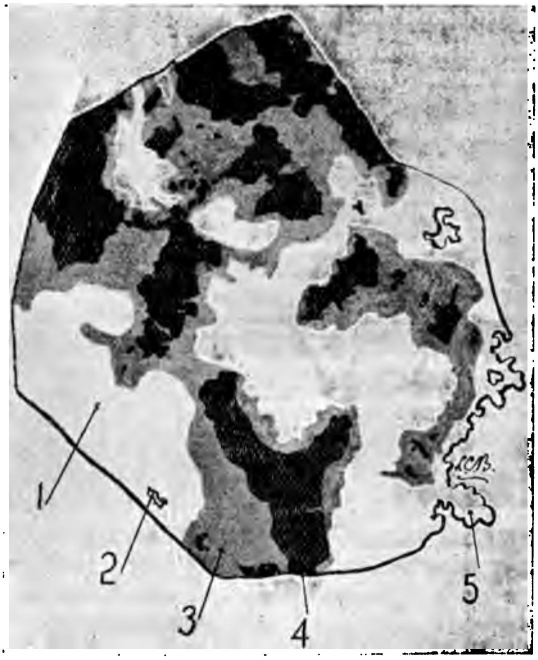


FIG. 8 (DOUBLE NATURAL SIZE).—CUPRITE-BEARING ORE, MOUNT HOPE NORTH.

1. Chalcedonic silica.
2. Cavity.
3. Malachite stained silica.
4. Cuprite.
5. Mammilated hyaline silica.

No. 5 shaft was sunk to prove a parallel crop of quartzite to the south-east of the main one. The rock on the tip is chloritic schist, with some bunches of copper-stained quartzite and a little chalcedonic quartz, distributed through which cuprite occurs irregularly scattered, surrounded by a staining of malachite. It is understood that 12 tons of 23% ore was despatched from here. This is the only place on the ground from which any shipping ore has been obtained.

Regina North (M.L. 636).

Mgr., Burns.

LOCATION, ETC.

This lease adjoins Mount Hope North at the south-western corner.

The area is 10 ac. This lease had not been surveyed when inspected. It is the property of a Melbourne syndicate.

DEVELOPMENT.

The only work in progress was the sinking of a shaft 50 ft. west of the Mount Hope quartzite crop in the north-eastern corner of the lease. It was then 40 ft. deep. The sinking of this shaft and that on the Mount Hope No. 1 was the only work then going on in the Mount Hope Group.

ORE-BODY.

The Mount Hope North quartzite bends and runs south in this lease. At the south-western corner of the northern lease it is slightly cupriferous, but in this is quite barren. The crop, which is rather cherty in parts, frays out about 5 ch. south of the Mount Hope North, but several other isolated crops appear on the line of strike to the south. The shaft is being sunk 50 ft. distant to the west of the crop, to catch the quartzite on the underlie, but at 40 ft. depth was still in schist. There appears to be no justification for sinking here.

Regina (M.L. 483).

Mgr., Burns.

LOCATION, ETC.

It adjoins Mount Hope on the north, at the western end.

Its area is 15 ac.

There are no workings.

ORE-BODY.

A large body of barren iron-stained quartzite enters the lease at the southern end. Its strike is north-west, while that of the country is definitely north and south.

Aurum (M.L. 482).

LOCATION, ETC.

It adjoins Mount Hope on the north, at the eastern end.

Its area is 5 ac.

No work has been done.

ORE-BODIES.

None. The country is silicified slate.

Mount Hope No. 1 (M.L. 627).

LOCATION, ETC.

This adjoins Mount Hope on the south.

The area is 5 ac.

One shaft near the northern boundary 38 ft. deep, in process of sinking in January, 1907.

ORE-BODY.

There is no crop here, the shaft being sunk in search of that cropping in the south-western corner of the Mount Hope, but there is no justification for the work.

Mount Hope South (M.L. 491).

LOCATION, ETC.

This lease is 10 ch. south of the Mount Hope.

The area is 30 ac. The lease, being deserted, was not inspected.

There are no workings.

ORE-BODY.

A large crop of copper-stained quartzite, of the character of the others in the Mount Hope group, is visible from the road.

Monarch Senior (M.C. 352).

LOCATION, ETC.

The Monarch Senior is about 3 miles east of Mount Hope and ¼ mile south-by-west from the Blue Jacket, on Spring Creek waters.

Four men's ground, 400 ft. × 350 ft. Deserted.

DEVELOPMENT.

The southern shaft is 50 ft. deep; 1 ch. to the north-east is a pit 6 ft. deep; 50 ft. to the north-north-west of the pit there is a shaft 30 ft. deep; just to the north of the last is a pothole; and a chain beyond there are two others.

OUTPUT.

1905 ... ... 5 tons shipped, containing 28% copper.

ORE-BODIES.

At the southern end there is little outcrop, but at the northern end 18 in. calcite can be seen, and beyond the northern potholes cupriferous limonite boulders are scattered over the surface for a distance of a chain.

The southern shaft being ladderless, a descent could not be made. The country is black chloritic schist, in which the ore probably occurs in bunches. The firsts at grass, 5 tons, consist of chalcopyrite, with infilled chalcocite, free from quartz and likely to yield 40% copper. The seconds, amounting to 5 tons, consist chiefly of limonite with veinings and infillings of carbonates and traces of silicate, and will run 15% copper. The tip, as a whole, may be expected to carry 5% copper. A specimen of pyrite, said to have come from the bottom of the shaft, was shown me. It bore signs of having suffered leaching, and was said to have been directly overlain by glance and covellite (?).

The pit to the north-east presumably was opened on a bunch, for schists only are now visible in the hole. There is about 1 ton of 10% ore at grass.

At the central shaft about 10 tons of 20% ore lies at grass. This is gossany limonite, with stains and impregnations of malachite, some tile ore, and a fair quantity of chalcopyrite, as usual partly converted into chalcocite and limonite and tesselated in appearance.

In the northern potholes only boulders of cupriferous limonite were found.

There is thus no evidence of any large quantity of ore on this claim, but it must be remembered that most of the surface is covered by quartz and silicified schist gravel, which hides the softer rock.

Blue Jacket (M.L. 632).

LOCATION, ETC.

The Blue Jacket lies about 3 miles east of Mount Hope, among lowlying rounded, rolling but stony ridges.

The area is 5 ac.

DEVELOPMENT.

The shaft, 15 ft. deep, is located centrally in the eastern part of the lease; from it a stope has been carried northwards the full depth for 12 ft., and at the bottom a drive is being carried still further north. The only other work done here is a trench 3 ft. deep running 12 ft. north of the stope.

OUTPUT.

3½ tons shipped, containing ... ... 26½% copper.

ORE-BODY.

The north and south striking shoot of ore is believed to be pitching northwards from the shaft, in the southern end of which is exposed 4 ft. width of calcite, with bunches of quartz-bearing limonite. This crop can be traced for 10 ft. south of the shaft.

In the northern end of the stope also a well-defined formation, carrying calcspar, occurs, but the ore in the floor of the drive has pinched to 6 in. in thickness.

In the northern end of the trench no limestone is visible, but the ore is 12 to 18 in. wide, and here comprises high-grade glance and tesselated glance-chalcopyrite, with bunches of quartz and tile ore veined with atacamite.

The ore at grass ready for bagging amounts to 3 tons. It consists in great part of dense glance and chalcopyrite with cuprite, radiating malachite and native copper in limonite stained with malachite. The association of native copper with calcium carbonate is to be noted as almost a general rule. One of the claim-holders showed me a sample of cuprite and native copper, which should yield over 80% copper, but the smelter's return for similar ore is alleged to have been only 26%, the reason given being that it should have been sent as matte. In addition to the above, there are 1½ ton bagged at the shaft and 7 bags of cuprite. The seconds, 6 tons, include limonite with malachite veins, impregnations and stains, and the heap ought to run over 15% copper. The 3½ tons of ore shipped from here yielded only 26½% copper, owing, some assert, to the inclusion of much barren ironstone.

The shaft is to be deepened, as, although the ore may be bunchy, the formation will go down. Still it must be acknowledged that no large output is to be expected.

GEOLOGY.

The country rock is a black chloritic schist, and in the western and northern part of the lease dykes of aplite are abundant. The crystals of pink orthoclase are especially well developed, often set separately in a matrix of quartz.

In the vicinity of Sergeant's Camp, ½ mile to the north-north-west of the lease, calcite veins are very abundant in dark schists, but ½ mile beyond the camp pegmatite dykes are again in evidence, here formed almost entirely of quartz, the felspar crystals being widely scattered.

Little Beauty (M.L. 568).

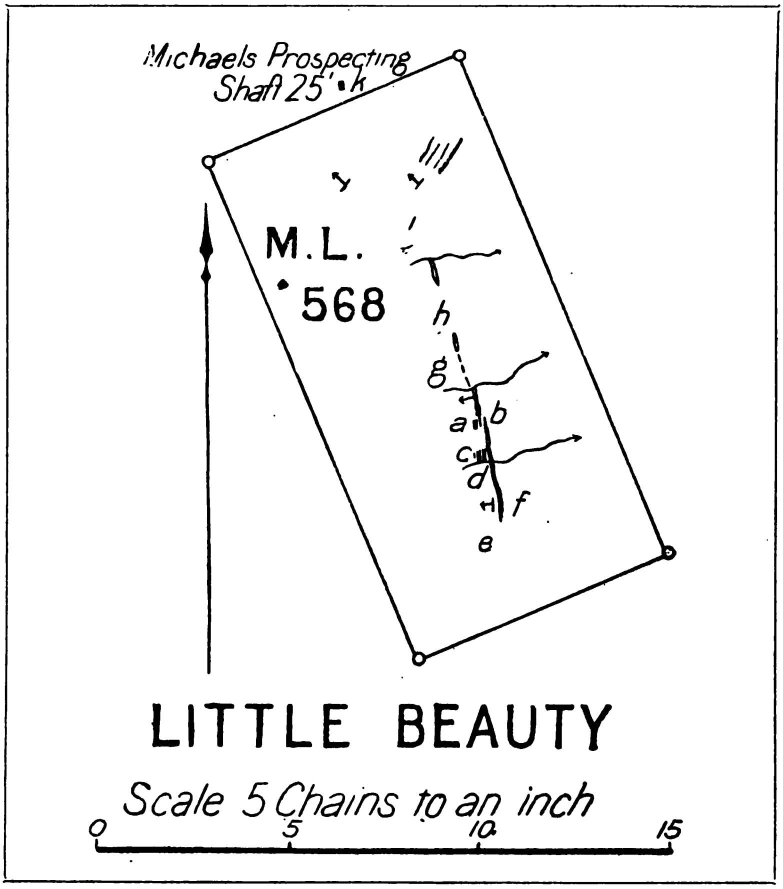
LOCATION, ETC.

The Little Beauty lies 2½ miles east-north-east of the Mount Hope leases, and is directly connected by dray track with Smith's store, on the Urandangi road.

The area is 10 ac.

DEVELOPMENT.

The workings, which are in the central southern part of the lease, comprise only a trench 4 ft. deep and a shaft 50 ft. deep, with drives 10 ft. east-south-east and 12 ft. west-north-west.



OUTPUT.

1906 ... ... 2 tons shipped, containing 29% copper.

ORE-BODIES.

The ore-bearing zone extends in a north-north-westerly direction over a distance of 7 ch., having a width in one place of 30 ft. Bunches of ore occur through this zone, but it is very doubtful if they are numerous enough for the deposit, as a whole, to be payably worked under any circumstances.

Beginning at the southern end, the country is stained with carbonates over a width of 15 ft., and has some bunches of fairly rich limonite-chalcopyrite-chalcocite ore, in addition to thin veins of gossan and quartz. At the gutter, 1½ ch. from the southern extremity, the formation contracts to 10 ft., and over 5 ft. width of country is included in this, but from the gutter for 30 ft. to the north the country is copper-bearing over 30 ft. in width. This formation should be trenched across in two or three places.

A promising gossan crop is then met, which can be followed northwards for 1½ ch., being 3 ft. wide near the centre.

Half a chain from the northern end of this crop it is over-lapped by another on the west. This is an irregular body of gossan quartz and copper ore (limonite with chalcocite and stains of malachite) 1 to 2 ft. wide, and from the trench opened on it 2 tons of 29% ore were obtained. It runs for only 1 ch. to the second gutter, beyond which only small bunches of gossan show at the surface for 1 ch., and then larger bunches, up to a few hundredweight each, of 10% gossan for ½ ch.

The country is then nearly barren for a distance of 1 ch., to a 12 in. crop of gossan extending 1 ch. to the third gutter. The schists 15 ft. to the north-west of this crop are stained over a width of 3 ft.

For 2 ch. north of the third gutter the country is slightly cupriferous over areas 10 ft. long and 2 ft. across, and one small patch of a few hundredweight of very siliceous carbonate stained limonite has been broken into. No other indication of copper can be found to the northwards on the line of strike, but the country here seems to have been abruptly deflected to the north-east, in which direction some gossany crops are to be seen.

Michael's prospecting shaft, to the north just outside the boundary, is 25 ft. deep. No crop shows here, and in the shaft only copper-stained decomposed gneiss is visible.

The main shaft has been sunk in the west of the overlapping outcrops. Ore comes in from the east at 25 ft. below the surface, and thence dips to the western side of the shaft at the bottom, where the body is nearly vertical. The eastern crosscut is in decomposing gneiss, streaked vertically black and white, but the western has pierced a well-defined formation 12 ft. wide. At least one quarter of the formation consists of bunches of malachite-stained limonite, containing chalcopyrite altering into chalcocite—the proportion of copper being perhaps 3%, but not more. It is noticeable here, as in many other places, that the smaller nodules are rich in secondary sulphides, the larger being more often poor limonite. The formation should be prospected by further sinking, as the percentage of copper may increase at a depth.

The country on the west at the southern end of the formation is altered gneiss and slate, with quartz lenses dipping 70° westwards; but further north silicified slates only are found; and, as mentioned, in the northern part of the lease, the strike changes to north-east. The country on the east is dark coloured gneiss. Aplite veins were noticed about a mile to the south-east of the Little Beauty. The rock is of somewhat striking composition, small crystals of pink orthoclase being scattered irregularly, and not very frequently, through a ground mass of quartz exhibiting a very distinct and unusual lamellar structure somewhat resembling the multiple turning of plagioclase.

The ore at grass not yet sorted, amounting to 3 tons, consists of tesselated ore (chalcopyrite altering into chalcocite) and malachite stained limonite almost free from quartz (that which is present being crystallised in cavities). It should average 20%, but probably 2 tons of 30% ore could be picked from it. The 10 tons of formation piled near the brace may carry 2% copper.

Mount Beauty (M.L. 705).

LOCATION, ETC.

The Mount Beauty lies ¼ mile east of the Little Beauty.

Its area is 5 ac.

No work has yet been done.

Ardath (M.L. 656).

LOCATION, ETC.

The Ardath lies between Green's Creek and the Urandangi road, ½ mile west of Smith's store and 4 miles south-east of Mount Hope.

The area is 10 ac. Exempt when visited.

DEVELOPMENT.

The main shaft near the centre of the lease is 52 ft. deep (inaccessible), and another near the southern boundary is 20 ft. deep. Besides these there are four potholes 1½ ch. south of the main shaft and 1 ch. south-east of the southern shaft.

OUTPUT.

3 tons shipped (report).

ORE-BODIES.

A crop of quartz and quartzite, striking north-east, comes into the lease from the south-west and peters out near the centre. The country for a chain to the south-east of this crop is much kaolinised, and carries bunches of good ore, over a length of 5 chains. The bunches are not, however, frequent enough for the whole belt to be mined nor large enough to warrant mining on a large scale for themselves.

The main shaft is sunk in kaolinised schist (stained bright yellow perhaps by traces of vanadium salts) containing 1 or 2% copper disseminated as carbonate with very occasional nodules of ore—malachite, chrysocolla and covellite (?), with inclusions of unaltered chalcopyrite reticulated with bluish chalcedony, probably introduced subsequently to the commencement of oxidation and tesselation of the chalcopyrite. A few hundredweight of earthy glance was got near the shaft bottom, and the proposal to continue sinking is sound, as much copper may have been leached downwards from the surface country.

The southern shaft proved 4 ft. in width of chloritic schist, stained and replaced by malachite and containing bunches of gossan and chalcopyrite altering into glance. It is reported that 3 tons of ore has been shipped from here; the 10 tons seconds at grass, cupriferous kaolinised country, probably average 5% copper.

In the pothole to the south-east of this shaft a width of from 1 to 5 ft. of kaolinised country is copper bearing. Some gossan was raised from here, but it is very siliceous.

At the pothole to the south of the main shaft there are several small gossan crops, and the holes, which went down in calcareous kaolinised country, struck occasional bunches of gossan carrying malachite and chrysocolla, sometimes with a little pyrite.

HAMPDEN.

LOCATION.

The township of Hampden, which has an elevation of 1,200 ft. above sea level, is situated 40 miles due south of Cloncurry and 50 miles west of Mackinlay, the distances by road being 50 miles and 60 miles respectively. The Mackinlay road is very seldom used because of its crossing a rather abrupt range. Under this heading are included the Hampden Group and mines in its vicinity and the Monitor Group.

HAMPDEN GROUP.

The Hampden deposits are quite differentiated from most others in the Cloncurry district, by being stockworks primarily and also by their association with diorite.*

Hampden (M.Ls. 244, 245, Etc.).

(Mgr., C. L. Smith.)

LOCATION.

The main workings are located within ½ mile to the north of the township.

AREA.

The company (known as the Hampden-Cloncurry Copper Mines, Ltd.) holds a total of 260 ac.— viz., as adjacent leases: M.L. 244 of 20 ac. (part of Block 37); M.L. 245 of 20 ac. (part of Block 38); M.L. 405 of 20 ac. (now known as Block 38 east); M.L. 406 of 20 ac. (now known as Block 37 east); M.L. 408 of 80 ac. (known as the Hampden North); and M.L. 407 of 80 ac.

Most of the mining has been done on the first two, though some prospecting has been carried out on the Hampden North. M.Ls. 405 and 406 are held as works sites. For fluxes—limestone and ironstone—two leases have been taken up—viz., M.L. 421 of 10 ac. and M.L. 422 of 10 ac. (known as Mount Sylvia).

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* Mr. Hartwell Conder, A.R.S.M., of Melbourne, has lately sent me some thin sections of specimens collected by him in the Cloncurry district. Examination of these with the microscope proves that certain rocks, resembling highly altered sedimentaries, found on the Argylla and Great Australia freeholds, are diorites, and the occurrence of that rock, altered to a greater or less extent, is, perhaps, much more widespread than was thought by me. Mr. Conder is now trying to trace the change from diorite to schist. Close study of limited areas may be expected to have some interesting results, among them being the proving that the copper has been derived from the diorite. The only hindrance to this work is the scarcity of outcrops of the country rock in the vicinity of the ore bodies.

TOPOGRAPHY.

The Hampden Mines lie in a wide flat-bottomed valley of mature age, there being on the east only remnants, such as Mount Sylvia, of the old Cloncurry pene-plain, though more extensive ranges are found to the north-west. Gidia and stunted gum are the only timbers and they are not abundant.

HISTORY.

In 1884 Mr. Warden Uhr marked out two mineral leases, called Eureka, which would appear to have been on the Hampden crops.

The first official mention of the Hampden Mine is found in a report by Mr. W. W. Alder, for 1898, in which year a Melbourne syndicate began prospecting operations under the management of Mr. Godkin. Two shafts were sunk, 40 and 50 ft., and 20 trenches opened. Ten tons of ore were shipped and 100 tons stacked. Much prospecting was done in 1899, and the ore raised from the open cuts was graded.

Work in the open cuts was continued during 1900, though it was not possible to ship the ore raised, because of the drought. Early in 1901 work ceased, owing to continuation of the drought, but was resumed towards the end of the year, only to be again thrown over on the failure of the wet season in 1902.

Operations were not again undertaken, owing to the low market value of copper, till 1904, when contracts were carried out in shaft No. 12, after which a six months' tribute (No. 1) was given to Entriken and party of ten men, who operated in opencuts Nos. 1 and 2. On the expiration of Entriken's term, F. Ferguson took a six months' tribute (No. 2), and raised ore from shaft No. 7. During 1905 the Company carried on operations, but no work of importance was done, teams for the carriage of ore being still scarce.

Early in 1906 the Company was re-floated as the Hampden Cloncurry Mines, Ltd. (300,000 £1 shares), and a start has now been made to sink three shafts 200 ft., and block out the ore. The present hauling equipment consists of only one winch and boiler, but it is understood that two others are in transit to the mine.

LITERATURE.

The full list of reports, numbered as below, will be found under the general introduction.

4. In his description, Mr. Cameron says "The Hampden Lode then appears to be a belt of vertical slates impregnated with cupriferous pyrites. Above the water-level the pyrites has been decomposed, and the copper concentrated into irregular masses by solution and redeposition from percolating water."

6. Mr. F. Stanley Low describes the workings in some detail, and mentions that the ore at grass comprised:

625 tons,	1sts	40%
2,691 „	2nds	13%
2,276 „	3rds	6½%

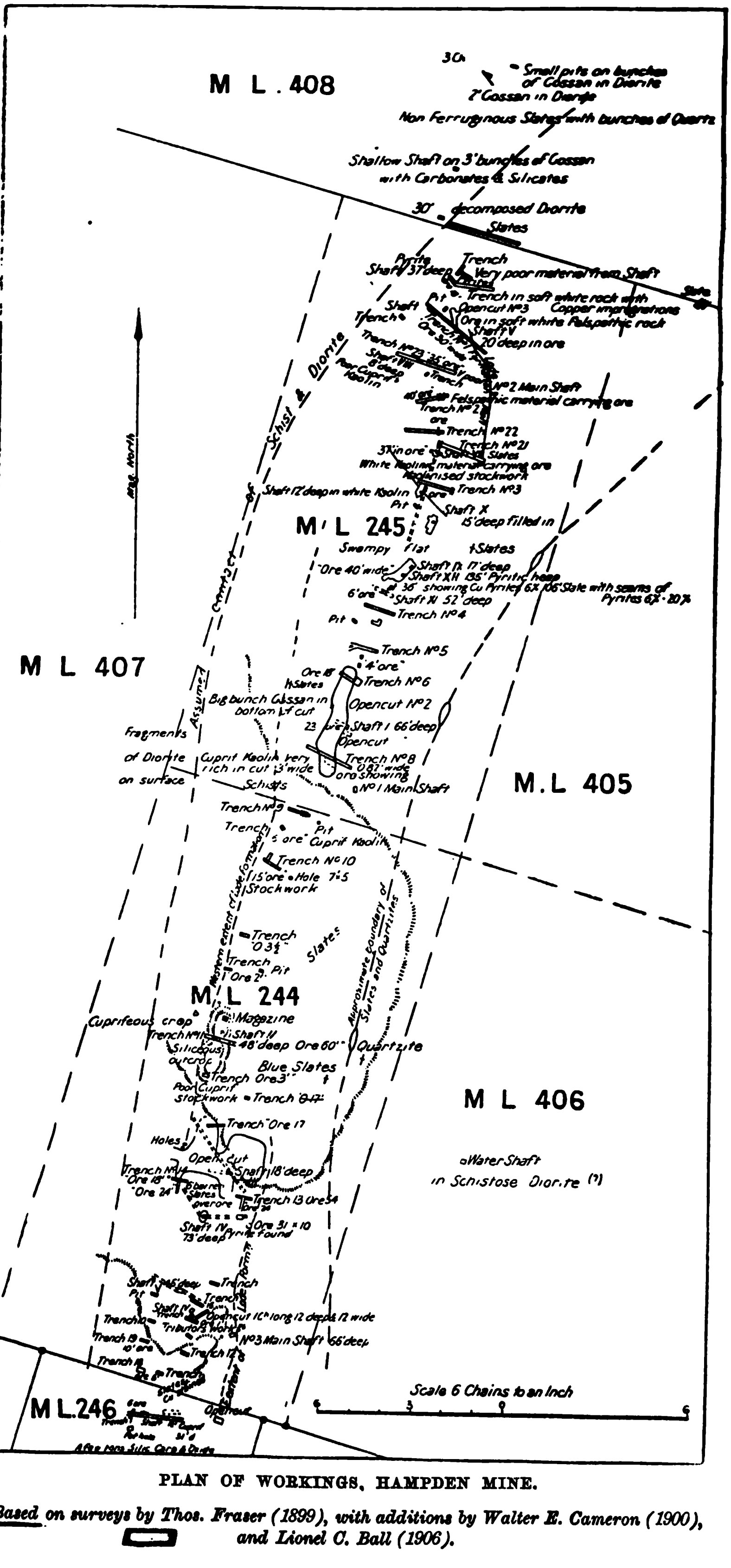
Mr. Low estimates the ore available for extraction as 116,000 tons, of an average grade of 15% copper, containing a gross value of £1,260,000.

8. A number of analyses, given in this report, are quoted below. Mr. Gibb goes into some detail as to the smelting qualities of the Hampden ores, showing that they require from 25% to 75% iron ore and limestone for fluxing, while the pyritic slate from No. 12 shaft would require no flux, "but, on the contrary, if this ore were proved to exist in sufficiently large proportion, it would, by the production of iron oxide in smelting, provide flux for the ore containing silica in excess, now rejected, and so reduce the cost of smelting the latter. . . . In the case of pyritic slate, represented by sample No. 27 from the Hampden Mine, no flux would be needed, and the smaller proportion of coke—as formerly explained—in pyritic smelting would reduce smelting cost to 22s. per ton." Mr. Gibb further estimates the profit per ton of ore to be £2 5s. 4d. He concludes that though the pyritic slate is very suitable for the cementation process, the cost of wet extraction including precipitant, would be £1 9s. 11d. per ton of ore, and, owing to the extreme slowness of natural oxidation, there would be no other advantage in adopting that process as against smelting.

9. Mr. Savage in a detailed report estimates that there is 183,000 tons of 11% ore in the kaolinised part of the lode, measuring 600 yds. long, 40 yds. wide, and 17 yds. deep.

DEVELOPMENT.

It will be noticed that except at shafts VII., 1, 2, and 3 and open-cuts Nos. 1 and 2, little has been done here since Mr. Cameron's visit. Mr. Smith, though ill at the time, helped me in every way during my brief stay at the Hampden.



PLAN OF WORKINGS, HAMPDEN MINE.

Based on surveys by Thos. Fraser (1899), with additions by Walter E. Cameron (1900), and Lionel C. Ball (1906).

▭

The workings extend from Block 15 on the south into M.L. 408 on the north, and comprise besides numerous pits, over 30 trenches, three opencuts, and 20 shafts, as shown on the accompanying plan by Mr. Fraser.

The trenches are from 3 to 200 ft. in length, and mostly less than 5 ft. in depth.

Open cut No. 1, near the centre of M.L. 244, is very irregular in form its greatest length being 3 chains and its width from 60 ft. to 140 ft., while its greatest depth is less than 20 ft. The cut is now being extended westwards.

Open cut No. 2 is 5 ch. in total length, but of this over a chain is simply an approach. Its average width is 40 ft., and its greatest depth is 30 ft.

Open cut No. 3, in the southern part of M.L. 245, is 40 ft. in length, and little can now be seen in it.

Shaft I. (in the side of open cut No. 2) is 66 ft. deep, and has short crosscuts east and west. Inaccessible.

Shaft II. on the ridge to the north of No. 1 cut is 84 ft. deep; at the 43 ft. level it has a crosscut 75 ft. to the west, and a drive 30 ft. to the south; and at the 84 ft. level a crosscut 65 ft. to the west. Inaccessible.

Shaft III. in No. 1 opencut was sunk 18 ft., and had a long crosscut running west-north-westwards.

Shaft IV. (near the southern boundary of M.L. 244) is 73 ft. deep, and has crosscuts 70 ft. east and 70 ft. north-west at the 60 ft. level. Inaccessible.

Shaft V. in the southern part of M.L. 244 is 45 ft. deep, and has crosscuts 40 ft. east and 60 ft. west. Inaccessible.

Shaft VI. 20 ft. deep with crosscuts 30 ft. in length at the bottom is at the south-eastern end of opencut No. 3. (It is incorrectly marked V. on the attached plan.) Inaccessible.

Shaft VII. in the northern part of M.L. 245 is 54 ft. deep and at the 50 ft. level has drives 60 ft. north and 150 ft. south with crosscuts 160 ft. east and 45 ft. west, at 20 ft. south of the shaft. In the western crosscut at 60 ft. from the main drive there is a 41 ft. winze.

Shaft VIII., in trench No. 23, is only 8 ft. deep. Inaccessible.

Shaft IX. in the centre of M.L. 245 is 19 ft. deep. Inaccessible.

Shaft X., ½ ch. to the north, is only 15 ft. deep and is filled in.

Shaft XI. is 52 ft. deep, and has cross cuts 20 ft. east and west. Inaccessible.

Shaft XII., between 9 and 11, is 135 ft. deep. A small winch has been installed here, and the shaft was being unwatered by baling in January, 1907, when an inspection was made—under difficulties. At the 80 ft. level there is a drive to the south off the western crosscut, and a drive for 45 ft. north from the shaft. At the 100 ft. level there is a crosscut in 15 ft. to the east, and a drive for over 100 ft. north of the shaft. A winze extends from the 80 ft. level to the 120 ft. level.

No. 1 main shaft is located off the lode in M.L. 245, near the dividing line with M.L. 245. It is now 40 ft. deep.

No. 2 main shaft has already been sunk 66 ft.—*i.e.*, to water-level.

No. 3 main shaft has also reached water-level.

These three shafts (each 12 ft. × 4 ft. in clear) are to be sunk to 200 ft. below the surface, and connected by driving, after which the deposit will be blocked out and sampled.

The well on M.L. 406 is 70 ft. deep in chloritic schist, and has a drive 40 ft. in length. The supply is 60 gall. per hour.

The workings on the Hampden North, all adjacent to M.L. 245, include several potholes and trenches, and one shaft 30 ft. deep.

OUTPUT.

		Tons.				£	s.	d.
1898—	... ...	10	37 % copper					
1901—2nd quarter	Co.	344 10/20	37 %	,,	valued at	9,646	0	0
—3rd ,,	,, ...	198	36 %					
1902—								
1903—								
1904—	Trib. No. 1 ...	118 10/20	30 %			2,148	8	0
	,, No. 2 ...	29	30 %			546	0	0
1905—	,, No. 2 ...	13	30 %			269	2	6
	,, ,, ...	131				3,026	10	0
(Ferguson)	,, ,, ...	11 18/20				252	18	0
	Co.	16				316	16	0
1906—3rd quarter	(Ferguson) ...	41				984	0	0
		12						
Total ...	... ...	924 18/20						

The seconds now at grass amount to:

8.600 tons, containing ... ... 10% copper*

GEOLOGY.

The Hampden deposits collectively have been usually referred to as a lode, though it has also been pointed out that they occur in a belt of slates between diorite on the west and quartzite on the east. Outcrops of the former are not by any means abundant except in the Hampden North, where the rock is slightly schistose. A dark schist found in the Hampden well may also be an altered diorite, but, as the Geological Survey Office is not provided with a lapidary, it has not been possible to make a petrological examination. The mine plan shows a zone of slates from 500 to 1,000 ft. wide, while that accompanying Mr. Cameron's report shows a belt with a uniform width of 350 ft. As a matter of fact, in spite of the multitude of workings, the exact width of the ore-bearing country has not yet been determined.

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* The heaps are now being sampled under Mr. Smith's direction. The assays have thus far proved the ore to carry up to 9 dwt. of gold per ton.

In the trenches and open cuts the country can be seen to be cupriferous over widths of from 3 ft. to 3 ch., and two parallel well marked copper-bearing zones, 1 to 2 ch. apart, can be traced through the leases, with interruptions and possibly in one or two cases coalescing; but there is no indication that the ores have infilled open channels, which would constitute a lode in the accepted sense. The ores near the surface occur as bunches and irregular veins in kaolinised slates, and the deposits should therefore be designated a stockwork.

The ore near the centres of the bunches is pure chalcocite, but outwards it gradually becomes impure, and ultimately shades into stained kaolin.

The richer ores have been found in only four circumscribed areas —probably the outcrops of shoots which, there is some evidence to show, are pitching southwards. The work done in shaft No. 12 indicated that secondary enrichment has taken place to a depth of at least 100 ft. in the country between the shoots. Consequently no considerable diminution of the average amount of copper per cubic yard is to be anticipated in the richer shoots for 100 ft. beneath the surface, the ores near the surface being richer but more scattered than in the neighbourhood of the water level.

The Hampden deposits have some resemblance to those worked at Clausthal, in the Hartz*, where occur zones of altered rock (clay slates, dipping slightly but foliated parallel to a plane of movement), 66 to 262 ft. wide, extending as far as 9 miles, and in which the ore bodies are somewhat irregularly distributed. The zones are the result of the friction of great masses which have been rubbed together. Galena pyrite and blende are the chief ores.

The occurrence of hæmatite at Mount Sylvia, in the immediate vicinity of Hampden, points strongly, however, to the ore-bodies being due to regional metamorphism of originally cupriferous eruptive rocks—the "diorite" found within short distances of the main workings. These conditions are not unfavourable for permanence in depth, as the copper derived from these rocks has been deposited in a crushed (schistose) zone traceable for long distances along the surface, and for that reason likely to descend below the limits of practical mining.

ORE BODIES.

The trenches have been opened for many years, and the exposures are therefore now not of the best; but in most of those on M.Ls. 244

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* Genesis of Ore Deposits. By Prof. Franz Posepny, p. 79.

and 245 cupriferous (carbonate) bands of country can be distinguished, and from many of them fair quantities of ore have been taken. The open cuts (Nos. 1 and 2), however, afford valuable information as to the nature of the deposits.

Open cut No. 1 is on the site of the richest area of ground yet located at Hampden. The ore, of which indications were first found by trenching and crosscutting from shaft III., consists of irregular bunches of cuprite and glance in kaolinised slates probably forming an indistinct shoot at least a chain wide pitching southwards beneath barren kaolin forming the southern side of the cut. The ore raised prior to 1901 from the cut, of which only the firsts have been shipped, comprised:

280 tons	40%
1,500 „	13%
55 „	6½%

Further quantities were obtained by the No. 1 tributers in 1904, and in removing the overburden west of the cut the manager is now recovering some rich ore. At the time of my visit in January 50 tons had been stacked. In this are scattered irregularly shaped kernels of cuprite, surrounded by encrusting laminated chrysocolla gradually passing outwards into slightly stained kaolin (Fig. 4).

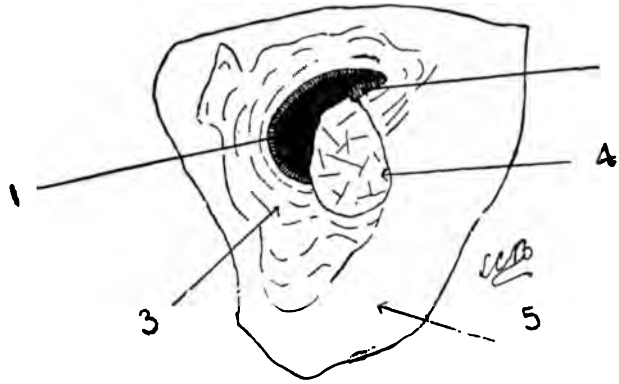

FIG. 4.—(NATURAL SIZE), OXIDISED ORE, SURFACE, NO. 1 OPENCUT, HAMPDEN.

1. *Crystalline cuprite.*
2. *Band of chrysocolla, blackened by cuprite.*
3. *Laminated chrysocolla.*
4. *Slightly stained ferruginous quartz.*
5. *Kaolin, slightly stained with chrysocolla, manganese dioxide and ferric oxide.*

Opencut No. 2 is in kaolinised slate with veins and bunches of carbonate stained cuprite and copper glance, forming a stockwork. There was little or no sign of ore at the surface, and the present faces do not appear to be worth more than 5% copper, though the ground is believed to be richer underfoot. Still, breaking down is to be continued, as the tributers last working naturally left only the poorest ore standing. The ore raised from the part of the cut north of shaft I. prior to 1901 included:

200 tons	40%
364 ,,	13%
1,184 ,,	6½%

The No. 1 tributers during 1904 extended the cut, and considerably augmented the heaps of ore at grass.*

Near the bottom of the cut is a body of gossan, in the interior of which some pyritic ore was found. This was originally chalcopyrite. It presents the appearance of having been cracked in all directions and subjected to leaching along the faces formed. Some of the copper has been redeposited in the openings as glance and cuprite, while oxidation has taken place to malachite and tenorite. The ore therefore, though at first glance thought very poor, proves to be moderately high in grade.

Opencut No. 3 yielded previously to 1901:

7 tons	40%
28 ,,	13%
8 ,,	6½%

besides which rich ore is reported underfoot. The cut exposes a kaolinised stockwork.

In shaft I. a body of glance was struck, yielding 75 tons of 20% ore.

In shaft II. white kaolin, with bunches of pyrite (carrying 1% copper) was found below black slate, with pyrite on joints.

Shaft III. proved the rich ore afterwards worked in open cut No. 1.

In shaft IV. rich ore was struck in sinking, and pyrite is also reported from it. It is understood that the slates dipped steeply west-

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* Mr. Gibb tabulates the following analyses of ore from No. 2 opencut (Government Analyst):—

S = selected for shipment.
R = rejected from ore raised.

	S.	S.	R.	R.
Copper	32·1	42·1	24·1	11·0
Silica	31·2	19·2	38·4	52·9
Iron protoxide	4·6	7·6	5·5	3·5
Alumina	8·8	4·3	8·6	13·9
Lime	trace	trace	0·5	0·5
Sulphur	—	6·4	—	—
	76·7	79·6	77·1	81·8
Gold	trace			
Silver	9 dwt. per ton.			

wards in the western crosscut. The ore-body was reported in 1900 to be 70 ft. wide at the 60-ft. level, and to assay up to 20%.* The total raised was:—

13 tons	40%
28 ,,	13%
197 ,,	6½%

The ore at grass consists of kaolinised slate with veins of carbonate-bearing kaolin passing into fairly rich oxide and glance ore.

Shaft V. was sunk in ore, but no classification was made of it. The manager in 1900 reported 111 tons of 13% ore at grass.

In the shaft VI. 30 ft. of ore was reported in the crosscuts.

In sinking VII. shaft a large body of ore was met, and the ore raised comprised:

12 tons	40% ore
72 ,,	13% ,,

During 1905 and 1906 an additional 200 tons of ore—black oxide (?) and glance, with stains of malachite—running from 38 to 51% copper, was broken down in the stopes just north of this shaft. It was possible to descend these stopes to the 50 ft. level, and it was then found that the irregular ore-body worked in the stopes had been driven on for 40 ft. north of the shaft, beyond which the country is only slightly stained but kaolinised. South of the shaft kaolinised slates, dipping 80° to the east show only occasional signs of ore, but there is a cap of gossan half-way along the drive. There is a possibility of bodies being tapped by short crosscuts, and the gossan cap should be sunk on. In the western crosscut only a few small patches of gossany ore were found, but in the eastern, at 60 ft. from the shaft, a body 30 ft. in length and 6 to 15 ft. wide, has been stoped out. This was sunk on by winze to 22 ft. below the crosscut. Beyond the stope only barren black slates, with bands of white kaolin, can be seen.

Shaft VIII. does not appear to have yielded any ore.

In shaft IX. no ore of consequence was found.

Shaft X. simply gave promise of ore.

Shaft XI. did not strike any body of importance.

In shaft XII. the former manager found the copper-bearing slates, at 50 ft. depth, to assay 9·% copper; at 59 ft., pyrite associated with gossan—assaying 6·5% copper—was struck; at 72 ft., the pyrite assayed 27·4%; at 74 feet, a vein of pure glance was cut; at 75 ft., the pyrite assayed 22·4%; at 82½ ft., 21%; at 97 ft., 6·2%; and at 107 ft., 4·2%. The workings had not been cleaned up when inspected by me, and my examination was therefore imperfect;

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* Report by Mr. Godkin to the directors.

but at the 80-ft. level friable pyrite* as bunches and veins, with some coatings of secondary sulphide, could be seen in kaolin, the whole apparently a partly oxidised and leached stockwork.† On the 100-ft. level sulphides can be seen near the shaft, but the northern drive shows little sign of ore, the country being slate. The northern drive on the 100 ft. level is in slate.‡

No. 2 main shaft struck siliceous gossan dipping west and pitching south at a depth of 45 ft.

No. 3 main shaft has as yet proved only barren slate.

Most of the workings on the Hampden North are in diorite, in which small and irregular bodies of gossan can be seen, in one place carrying both malachite and chrysocolla. The slates would appear to have been deflected to the north-east, where some prospecting should therefore be done.

PROBABLE ORE.

The first rich area may be taken to extend from open cut No. 1, near the northern boundary of M.L. 245, almost to shaft No. 10—a distance of 450 ft.; and it has been proved in places to be 30 ft. wide, while it may have double that width in others. The second (at opencut No. 2), in M.L. 245, is 400 ft. long, and up to 40 ft. wide. The third (at opencut No. 1), in M.L. No. 244, is 300 ft. long and 200 ft. wide. The fourth, at the southern boundary of M.L. 244, is 200 ft. long and 20 ft. wide. These areas, it must be understood, are exceedingly ill defined, and the amount of ore available is very problematical.

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* Analysis given by Mr. Gibb, of "pyrite" (Government Analyst):—

Copper	=	0·3 %
Silica	=	11·0
Iron protoxide ...	=	48·1
Alumina	=	4·1
Sulphur	=	37·6
		101·1

Gold = trace
Silver = trace

† Analysis, tabulated by Mr. Gibb, of "pyritic slate" from drives at the 80 ft and 100 ft. levels, No. 12 shaft (Government Analyst):—

Copper	=	10·5
Silica	=	13·1
Iron protoxide ...	=	39·8
Alumina	=	6·6
Sulphur	=	27·3
		97·3

Gold = 10 gr. per ton
Silver = 1 oz. 0 dwt. 14 ,, ,, ,,

‡ Analysis, given by Mr. Gibb, of "country rock" (Government Analyst):—

Copper	=	0·8 %
Silica	=	57·1
Iron protoxide ...	=	7·5
		65·4

Taking the areas given above, the total material in the shoots above the 100-ft. level, assuming 15 cub. ft. per ton, will be 625,000 tons. The ore taken from the open cuts, reduced to a 10% basis, amounted to two-thirds of the material moved. But there is a likelihood of the average being below this, and, for purposes of illustration, placing it at one-sixth, the probable amount of 10% ore above the 100-ft. level will be 100,000 tons. The total quantity of ore in the shoots may be much less than this, but will then be of correspondingly higher grade.

TREATMENT.

Till recently, with cartage to Hughenden costing £8 per ton and railway and shipping freight 30s. extra, the total cost of mining, transporting, and treating (at customs works) a ton of 30% ore has amounted to nearly £14; and even with the railway at Cloncurry and cheapened mining costs it is likely to still reach £8. At the present time nothing less than 20% is bagged, and even with copper at £100 per ton nothing less than 10% ore would pay to ship, and a slight fall would necessitate closing down the mine.

The company has therefore always desired concentration, but their ores, so far proved, are chiefly oxidised, and not suited for vanning, and they now propose to erect smelters. The scarcity of timber in the district is a recognised difficulty, but it is hoped to make up for this deficiency by the addition of sulphides from the lower levels.

None of the wet processes have yet been considered, but that known as Neill's should certainly be given a trial. In this process the sulphur dioxide given off during roasting is used to dissolve oxides and carbonates as sulphite, which is precipitated by heat and reduced to metallic copper simply by fusion, sulphur dioxide being regenerated*.

Block 15 (M.Ls. 246 and 409).

Mgr., Hogarth.

LOCATION, ETC.

Adjoining M.Ls. 244 and 406 (Hampden) on the south.

Each lease is 10 ac. in extent.

WORKINGS.

The workings, which are all on M.L. 246, comprise a number of potholes in the northern part of the lease, several trenches, an open-cut, and two shafts. The inaccessible main shaft near the centre of the lease is 80 ft. deep, and has a crosscut running 170 ft. to the west. The second shaft has only just been begun, about 5 ch. north of the main shaft, and when inspected there was one man at work here.

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* See Wet Processes of Copper Extraction. By L.C.B. G.S.Q., No. 193.

Ore Deposits.

At the southern end of the lease there are crops of ferruginous clay slates over a width of two chains, with blows of siliceous gossan 6 ft. thick and a chain long, two chains apart. The main shaft was sunk alongside one of these blows, in black pyritous slates dipping steeply to the east, but failed to prove it continuous downwards, and in the crosscut only slates were found—dipping steeply west.

In the open cut, near the northern boundary and east of any of the Hampden workings, black slates occur, veined with green carbonate and strongly impregnated with chalcocite over a width of 10 ft. (Fig. 5).

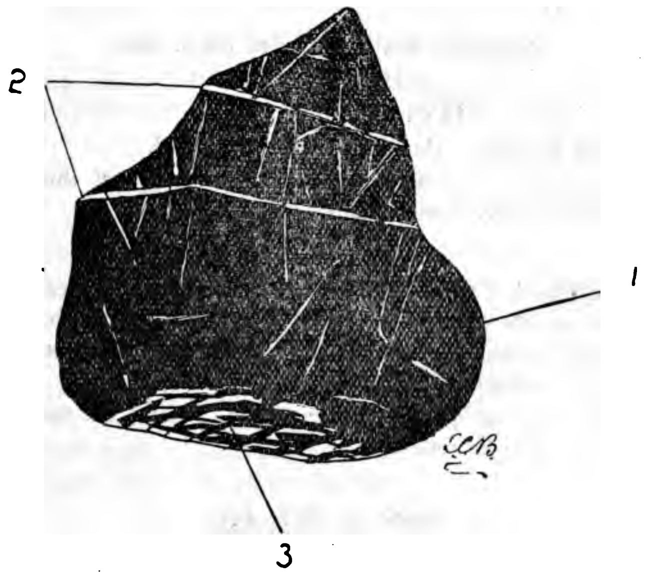


Fig. 5.—(natural size), stockwork, opencut block 15.

1. Black slate, with disseminated chalcocite. *2. Malachite.*
3. Malachite replacing slate.

The trench to the west of this exposes slate, veined and impregnated with carbonate and oxide. About 30 tons of ore has been stacked, probably containing 5% copper.

Two chains south of this is another trench and shaft, where silicified gossan is visible at the surface; while below is limonite with quartz crystals and stains of malachite. There is about 20 tons of 1% ore stacked here.

There is thus—except the chalcocite slate in the open cut—nothing of present value showing on Block 15, though copper ore may be found beneath the gossan; but there is some hope of the southernmost shoot of rich ore in M.L. 244 pitching into this property at a depth.

Mount Sylvia (M.L. 422).

LOCATION, ETC.

Mount Sylvia lies about 1½ miles south-east of the Hampden workings.

This lease of 10 ac. is held by the Hampden Company for ironstone flux.

ORE.

Mr. Smith informed me that the ore assays 87·87% iron oxide. Specimens given me consist of non-magnetic crystalline granular hæmatite, with thin veins of limonite. The association of hæmatite deposits with those of copper is suggestive, again, of a genesis due to regional metamorphism.

Hampden South Extended (M.L. 394).

LOCATION, ETC.

Adjoining M.L. 246 on the south.

Its area is 10 ac. Unmanned when inspected.

One trench 2 ch. from south-western corner on the southern boundary is the only development.

DEPOSITS.

In the trench 2 ft. of limonite, with secondary silica, can be seen, as well as on the surface for a few chains to the north. This is probably only a bunch, but is worth sinking on, being on the continuation of the Hampden line.

Another crop of quartz-bearing gossan, lying 5 ch. north of the above, should also be tested.

Block 25 (M.L. 421).

LOCATION, ETC.

This lies 7 ch. west of the north-west corner of M.L. 407.

Its area is 10 ac. This lease is held by the Hampden Company for limestone flux.

DEPOSITS.

In the north-western corner a crop of calcite can be traced for about a chain in decomposed diorite. It is 18 in. thick, and dips northwards. The calcite is accompanied by quartz (which appears to increase in depth) as well as small patches of limonite and occasional flakes of chlorite.

Ten chains west of the above is another crop of grey calcite, 2 to 3 ft. wide, and vertical, striking east and west. It has been trenched for 1 ch., and can be traced for ½ a ch. beyond.

Other small crops may be found, but no large supply of limestone is to be expected here.

Hampden South Extended Block (M.L. 410).

LOCATION, ETC.

This adjoins M.L. 394 on the east.

The area of the lease is 10 ac., but there are no workings, and no deposits have been exposed. No one was present on the ground when my inspection was made.

Hampden Central (M.L. 501).

LOCATION, ETC.

This adjoins M.Ls. 394 and 410 on the south.

The area of the lease is 31 ac. The workings comprise only one trench, and the lease was deserted when visited.

DEPOSITS.

Only thin veins of carbonate in slate have yet been found here—nothing of importance.

Hampden South (M.L. 502).

LOCATION, ETC.

The Hampden South adjoins M.L. 501 on the south.

Its area is 31 ac. The lease was unmanned when inspected, but Mr. Hazard, one of the former owners, conducted me over it.

WORKINGS.

Three trenches and two potholes. Pothole (*a*), 4 ft. deep, is 5 ch. from the southern boundary; trench (*a*) is ¾ ch. to the north; shaft (*b*), 10 ft. deep, is ½ ch. beyond; trench (*b*), 6 ft. deep, is ½ ch. beyond; and cut (*c*) is 5 ch. further north.

ORE DEPOSIT.

The crop is a well marked one of ferruginous quartzite passing into siliceous limonite and gossan (generally with a body of cellular limonite on the east), standing in some places 5 ft. above the ground, and exposed for a length of 12 ch. from the southern boundary. Its dip seems to be to the east.

The main workings are along the eastern side of the crop, adjacent to where the crop is most siliceous. The main shaft (*b*) is sunk wholly in cellular limonite, with quartz crystallised in cavities, and containing disseminated malachite. About two tons of 15% ore have been paddocked, while 7 bags of picked ore are reported to have yielded 20%.

The deposit should be sunk on where less siliceous, as such cellular limonite must overlie copper ore—probably of some richness.

The country rock near the crop is slate, but diorite occurs within a few chains to the north-east.

Azurite (M.L. 561).

Brady and McBride.

LOCATION, ETC.

The Azurite lies 4 miles east of Hampden.

Its area is 5 ac. It was not visited.

Carbonate (M.L. 558).

Brady and McBride.

LOCATION, ETC.

The Carbonate adjoins the Azurite on the east.

Its area is 5 ac. It was not visited.

True Blue (M.L. 591).

Grey and Wheatley.

LOCATION, ETC.

The True Blue lies 1½ miles west-north-west of the Azurite.

Its area is $9\frac{8}{10}$ ac. It was not visited.

Block 33 (M.L. 247).

Mgr., Orr.

LOCATION, ETC.

Block 33 (or the Hampden West) lies 3½ miles west of Hampden.

Its area is 10 ac.

OUTPUT.

1904	... 15 tons	shipped	
1905	... 6 ,,	,,	by Woodhouse and Tait
	12 ,,	,,	,, Salveson
1906	... 22 ,,	,,	,, Woodhouse and Tait.

I.X.L. (M.L. 389).

Mgr., Long.

LOCATION, ETC.

The I.X.L. is understood to lie 3½ miles north-north-west of Hampden.

Its area is 9 ac. It was not visited.

MONITOR GROUP.

This group, lying 44 miles south of Cloncurry, includes the Monitor, Monitor North, Monitor South, Wooluma, Gorge, and Mount Devoncourt. The first is in slate country, but the last is reported to be in porphyry.

Monitor (M.L. 419).

Mgr., McEvoy.

LOCATION, ETC.

The Monitor is 44 miles south of Cloncurry, 8½ miles southwest from Hampden, and ½-mile from the Cloncurry River.

The area of the lease is 5 ac.

DEVELOPMENT.

The main shaft is 40 ft. deep; down to 15 ft. it is 10 ft. wide and 20 ft. long, and below it is 5 ft. wide and 10 ft. long. Only one other trench, 2 ch. to the south-east, was seen.

OUTPUT.

Total—65 tons despatched, 30 to 40 % copper (*fide* Mr. McEvoy).

There are no returns in the Warden's reports of ore from the Monitor.

ORE-BODIES.

In the southern trench a gritty kaolinised rock striking north-north-east is exposed. This rock shows flakes and stains of malachite, but the average tenor of copper is below ½%.

Northwards towards the main shaft ferruginous quartzite crops out alongside schistose slate, and at the shaft schists and quartzites over a width of 10 ft. have been irregularly impregnated and replaced by copper ore. Near the surface the rocks are stained by malachite and azurite and carry bunches of ore (limonite, malachite, and glance). The dark chloritic schist towards the shaft bottom is reticulated by thin veins of malachite, and contains splashes of glance, the ore on the whole being rather better than that above.

Some 65 tons of 30 to 40% ore have been despatched, and the seconds—dark slate with malachite and azurite stains—amounting to 150 tons, should contain 5% copper. There is also at the brace 3 tons of ore last raised—comprising black schistose quartz-veined slate, seamed in all directions by malachite (as on Hampden Block 15), and carrying a few bunches of tile ore. This, as it stands, should assay over 10 per cent. copper.

Monitor North (M.L. 533).

LOCATION, ETC.

This adjoins the Monitor on the north.

Its area is 5 ac. No work has been done on this.

Monitor South (M.L. 534).

LOCATION, ETC.

This adjoins the Monitor on the south.

Its area is 5 ac. No developments have yet taken place here.

Mount Devoncourt (M.L. 550).

Mgr., Staubwasser.

LOCATION.

Mount Devoncourt lies 12 miles south-east of Devoncourt, on the main branch of the Cloncurry River, 2 miles from the Hampden road, and 42 miles south slightly west from Cloncurry. It is not shown on the lease map.

The hills both north and south of the Cloncurry River rise to a fairly uniform elevation of about 100 ft. above the flood plain, of the Cloncurry River and mark the level of a peneplain, out of which the river has cut its valley.

AREA.

The area is 10 ac. The lease was taken up under the name of Mount Merlin, but is more commonly known as the Devoncourt. It is rumoured that the Mount Merlin Company has abandoned the mine, but the manager's reports make it unlikely to be the case.

The mine was deserted during my stay in the locality, and an attempt made to locate it proved unsuccessful, owing to inadequate directions.

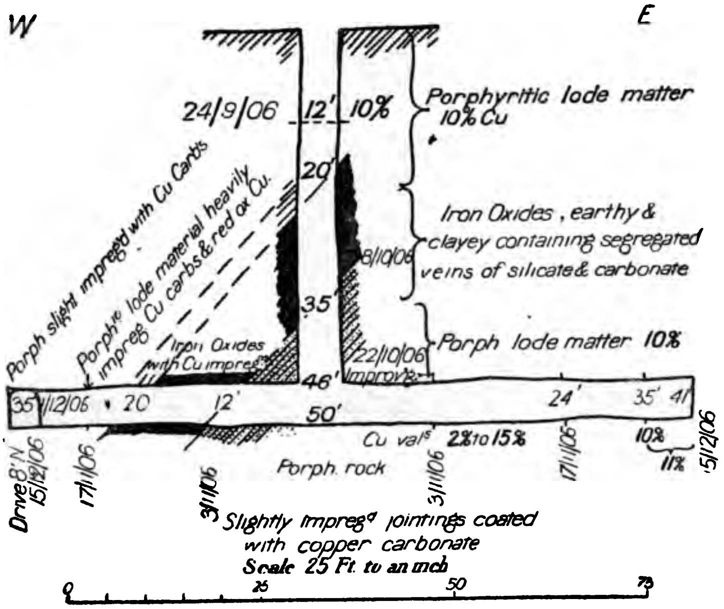
DEVELOPMENT.

From the manager's reports published in the Brisbane Press, it is learnt that the company began work in September, 1906, cleaned out an old shaft 12 ft. deep, continued sinking to 50 ft., and then at the bottom opened crosscuts 41 ft. east and 35 ft. north, also driving 8 ft. north from the end of the latter.

ORE-BODY.

It is understood that there was no ferruginous crop at the surface, but the several costeans "show a wide and lengthy expanse of cupriferous material."

The shaft, sunk apparently near the centre of the ore-body, proved "porphyritic lode material," assaying 10% at 12 ft. depth. From 20 to 35 ft. the sinking was in "iron oxides, earthy and clayey, containing segregated veins of hydrous copper silicates and carbonates." Below the ironstone there is again, as above, porphyritic material carrying 10% copper to 46 ft. depth, but the porphyritic rock in the shaft bottom is only slightly impregnated, though the jointings are coated, with copper carbonate.


W
E
24/9/06
12'
10%
Porphyritic lode matter 10% Cu
20'
Iron Oxides, earthy & clayey containing segregated veins of silicate & carbonate
8/10/06
35'
Porph lode matter 10%
22/10/06
Improv'g
46'
Porph slight impreg'd with Cu Carb's
Porph'c lode material heavily impreg Cu carbs & red ox Cu.
Iron Oxides with Cu impreg's
35
1/12/06
20
12'
50'
24'
35'
41'
Cu val's 2% to 15%
10%
11%
Porph. rock
Drive 8' N. 15/12/06
17/11/06
3/11/06
3/11/06
17/11/06
5/12/06
Slightly impreg'd jointings coated with copper carbonate
Scale 25 Ft. to an inch
0
25
50
75

SKETCH SECTION OF MAIN SHAFT, MOUNT DEVONCOURT.

The western crosscut is in "iron oxides, with small patches of copper impregnations" for from 12 ft. to 20 ft. from the shaft, and adjacent to this body is "porphyritic lode material heavily impregnated with copper carbonates and red oxide of copper," but the drive at the end of the crosscut is "in porphyry, slightly impregnated with copper carbonates."

In the eastern crosscut the amount of copper gradually increased with distance from the shaft, and between 12 ft. and 24 ft., it varied from 2 to 15%, the average of the last 6 ft. being 11%.

From these data it would appear that there is a gossan body, 10 ft. thick, dipping westwards through the shaft and the western crosscut. This, if correctly described by the manager, should prove rich in copper above water level, below which cupriferous pyrite may be expected. The whole formation exposed on the 50 ft. level would appear to be a deposit of some promise, the manager's statement being: "At the 50 ft. level we have a copper-bearing formation 70 ft. wide, with ore still showing in the eastern face of crosscut. The copper occurs as an impregnation of porphyry, the copper content varying from 2 to 14%."

During my search for the mine it was noted that the country in this vicinity comprises felspathoid and granitoid rocks—apparently highly metamorphosed sedimentaries, with interbedded crushed porphyries. Attention has elsewhere in this report been drawn to the importance attached to low-grade chalcocite deposits in porphyry at Ely, Nevada, U.S.A., where in one mine the rock has been leached from the surface to 50 ft. or 100 ft. below, but still deeper has uniform though low copper values.

Wooluma (M.L. 631).

Location, Etc.

The Wooluma lies ½ mile north of the Monitor.

Its area is 10 ac. It was not visited.

Ore-bodies.

This lease is believed to be on the coutinuation of the Monitor line.

The Gorge (M.L. 484).

Location, Etc.

The Gorge is believed to lie 1½ mile west of the Monitor.

Its area is 20 ac. It was not visited.

FLORENCE RIVER.

The Florence mines are rather scattered. They comprise only 2 leases with 19 claims and 3 prospecting areas.

The following is a list of holdings in force at the end of the year 1906, of which the particulars available do not warrant their treatment under separate headings.

McPhail North (M.C. 200).—This adjoins the McPhail on the north. Its area is 800 ft. × 350 ft. No work has been done here.

McPhail South (Extended M.C. 234).—This adjoins the McPhail on the south. Its area is 800 ft. × 350 ft. No work has been done on it.

Edmonson (M.C. 222).—The Edmonson is near the McPhail. Its area is 1,600 ft. × 350 ft.

Dodger (M.C. 371).—The Dodger lies 3 miles south-east of the McPhail. Its area is 400 ft. × 350 ft.

Bobby Dazzler (Extended M.C. 365).—This is 2 miles north-west of Native Police Waterhole, Florence, and about 5 miles east of the McPhail. Its area is 400 ft. × 350 ft.

Lottery (P.A. 301).—It is 3 miles north-west of the McPhail. Its area is 10 ac.

Orion's Belt (P.A. 260).—This is 4 miles west of Hart's Camp. Its area is 10 ac.

Frances (Extended M.C. 251).—This is at the Florence Waterhole. Its area is 400 ft. × 350 ft.

United (Extended M.C. 369).—Florence. Its area is 600 × 350 ft.

Better Luck (M.L. 580).—Florence. Its area is 9 ac.

Our Luck (M.C. 125).—Florence River. Its area is 200 × 350 ft.

Myall King (Extended M.C. 243).—Florence. Its area is 400 ft. × 350 ft.

Eclipse (M.C. 236).—Florence. Its area is 800 ft. × 350 ft.

Lady May (Extended M.C. 285).—Florence. Its area is 800 ft. × 350 ft. Output: 1906—7 tons.

Theresa (M.C. 271).—Florence. Its area is 200 ft. × 350 ft.

Juno (Extended M.C. 274).—Florence. Its area is 800 ft. × 350 ft.

Queen Cross (M.C. 260).—Florence. Its area is 1,600 ft. × 350 ft.

Vivian (M.C. 259).—Florence. Its area is 1,600 ft. × 350 ft.

Gem (M.C. 344).—Florence. Its area is 400 ft. × 350 ft. Output: 1906—$3\frac{13}{20}$ tons.

Mount Flannagan (Extended M.C. 269).—This is 1 mile south of the Native Police Waterhole on the Florence River. The area is 1,600 ft. × 350 ft.

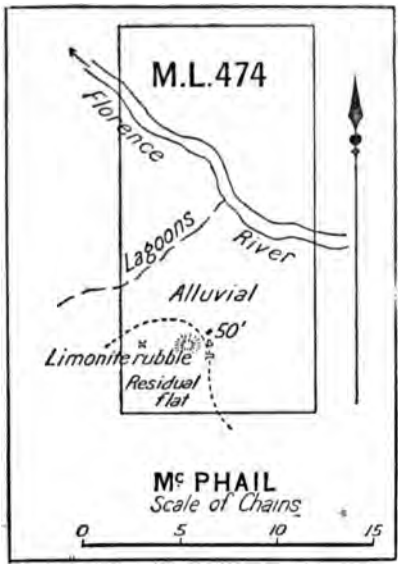
McPhail (M.L. 474).

Mgr., Brady.

Location, Area, Etc.

The McPhail is located on the Florence River, ½ mile west of the main Hampden road, and 33 miles south from Cloncurry.

Its area is 20 ac. This ground was first secured by a prospector named McPhail in 1884—as the Ironclad gold-mining lease. When visited, the present lease had just been placed under option to the Mount Elliott Company. From Press notices it is learnt that the property was taken over by the Company, in April of this year, a good body of high grade sulphide ore having been proved since my inspection.



The Florence River crosses the McPhail lease, and the greater part of which is consequently low-lying alluvium.

Development.

Very little work was done here till the present holders marked out the lease, and their workings, when inspected, were all in a flooded state, owing to late rains. They are all in the southern part of the lease, and comprise three trenches and a shaft. The southern trench, 3 ch. from the southern boundary is 30 ft. long, and at the eastern end is 8 ft. deep. Another trench, 40 ft. to the north, has two short branches, one to the east, 6 ft. deep, and one to the north, 16 ft. deep. The shaft, 30 ft. to the north of this trench, is 50 ft. deep. The western trench is 3 ch. west of the central trench.

OUTPUT.

	2 tons	shipped, carrying 33% copper (*fide* Mr. Brady)
1906 . .	7 ,,	,, ,, 24½% ,, (,, ,,)
Total	9 ,,	,,

ORE-BODIES.

In the south-western corner of the lease a mound of strongly ironstained quartzite and schist, 1 ch. in diameter, rises 15 ft. above the flat. It is on the eastern side of this mound, 1 ch. from the summit, that the main workings lie; but a trench on the rubble flat, 3 ch. to the west of the latter, opened on a patch of "copper weeds" (*polycarpœa*), exposes very promising cupriferous gossan veins with spheres of chrysocolla and malachite. There is consequently a possibility of bunches of ore occuring throughout the intermediate ground, the surface of which is covered with limonite rubble, and this should be borne in mind when sinking is undertaken together with exploratory cross-cutting.

There can have been little outcrop of ore, it being mostly hidden by alluvium, and for the same reason nothing has been proved as to the extent of the deposit, though there is a rumour of the crop having been seen in the river bed.

In the southern cut layers of gossan dipping flatly to the east can be seen, and from the hole at the eastern end of the cut green-stained gossan, containing some pockets of acicular malachite, was raised.

The northern trench exposes a body, 2 ft. 6 in. wide, of malachite-bearing gossan (10% copper), which is flat in the northern arm, but dips steeply to the east in the eastern arm. Gossan occurs beneath this body, and limonite with radiating malachite, and chrysocolla was reported at 16 ft. beneath the surface, but, of course, could not be seen by me because of water. In April, 1906, 7 tons of 24½% ore were despatched from here. Besides this there are 15 tons of seconds (15% copper) at grass, consisting of gossan with veins and bunches of malachite and chrysocolla. (Fig. 6.)

The shaft is said to have been sunk, except for one small block of bleached slate, wholly in ore. That from the upper part consists chiefly of limonite, veined with malachite and chrysocolla, and may carry 10% copper. There is 10 tons of it at grass. At 22 ft. depth an 18-in. seam of richer ore, 2 tons of which yielded 33% copper, is said to have been cut. About ½ cwt. of this ore at the brace consists of chalcopyrite altering into limonite and in parts almost completely replaced by chalcocite. The ore shown me as from the shaft bottom is limonite with disseminated malachite and small bunches of glance.

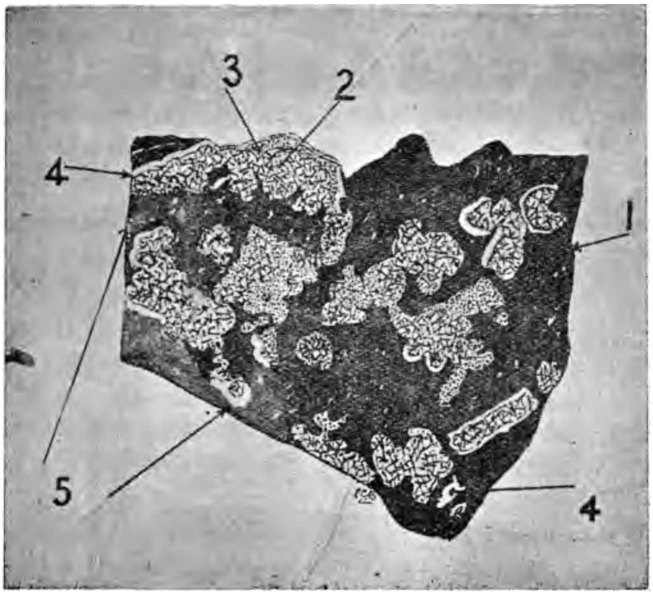


FIG. 6 (NATURAL SIZE).—OXIDISED ORE, M'PHAIL.

1. *Limonite.*	4. *Chrysocolla (encrusting)*
2. *Crystalline malachite*	5. *Tile ore.*
3. *Light earthy malachite*	

The whole tip at the shaft will probably run over 5% copper, and it contains very little quartz and quartzite. The absence of quartz from the ore paddocks and the high iron contents are conspicuous features at this mine, pointing to the occurrence of dense pyritic ores at a depth.

In connection with the flooded state of the shaft, it is asserted by the lease-holders that the water in the shaft is not affected by the river, although the latter is only a few chains distant, and its bed is but 15 ft. below the brace.

This property would be worthy of development even if there were only the rich bodies cut in the middle trench and in the northern shaft. The gossans here are soft and not likely to make noticeable crops at the surface, wherefore the bodies may yet be proved to have a considerable north and south extension.

Trump (Extd. M.C. 368).

Mgr., McBride.

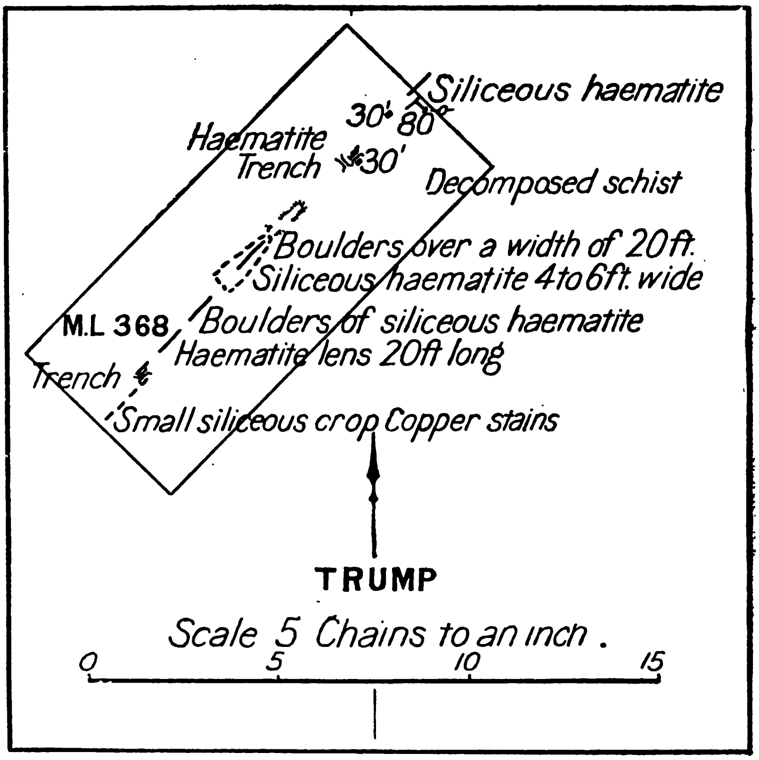
LOCATION, AREA, ETC.

The Trump is about 2 miles south-east of the McPhail.

Its area is 800 ft. × 350 ft.

DEVELOPMENT.

The workings comprise three trenches and two shafts. The northern trench, 1 ch. from the northern boundary, is 20 ft. long and 6 ft. deep; and a costean just to the south is 10 ft. long. The southern trench is 2 ch. from the southern boundary.



The northern shaft, 1 ch. south of the northern boundary, is 30 ft. deep.

The second shaft, 15 ft. east of the northern trench, is 30 ft. deep.

OUTPUT.

3 tons shipped, carrying 38½ %

ORE-BODIES.

The general strike of the ore-bodies here is north-east, and the dip, which is almost vertical, is to the south-east. The outcrops comprise detached lens-shaped masses of siliceous turgite* (sp. gr., 4·2) from 10 ft. to 2 ch. long and 1 to 6 ft. wide. The best of the copper ore is found between and alongside these outcrops, though a little chrysocolla occurs in some of the turgite.

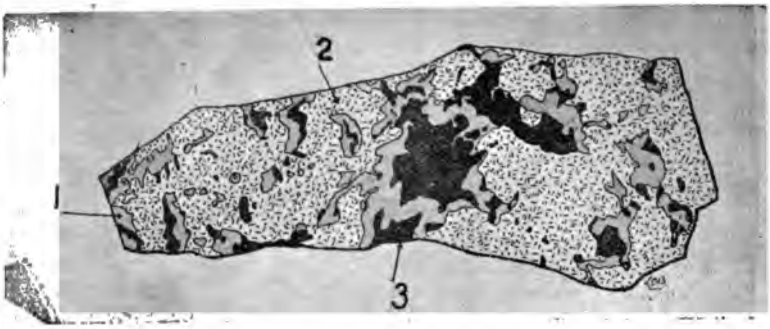


FIG. 7 (DOUBLE NATURAL SIZE).—OXIDISED ORE, TRUMP.

1. Chrysocolla *3. Dense limonite.*
2. Crystalline malachite

Crossing the northern boundary there is a crop of siliceous turgite a chain in length.

The northern shaft was sunk in decomposed schist, the footwall country of a body of copper ore at least 2 ft. 6 in. wide. The bulk of this ore is reddish limonite with disseminated malachite and veins of both malachite and chrysocolla (*see* Fig. 7); but along the footwall, which is not well defined, occur boulders of rich ore, consisting of fine grained glance, malachite, chrysocolla, and dioptase, with bunches of pyrite (*see* Fig. 8). Of the lower grade ore about 6 tons at grass may run 15%, while the richer, of which only ½ ton is paddocked, may yield 35% copper.

The northern trench exposes gossan, on the south-eastern side of a crop of turgite 5 ft. wide, which, in the costean, is seen to pinch to 12 in.

At the southern shaft there is at grass about 1 ton of earthy malachite, which will probably run 25% copper, and 3 tons of 38½% ore has been despatched from here.

At 1½ ch. south-west of these workings boulders of iron stone are scattered over a width of 20 ft., for a distance of 1 ch., and 12 ft.

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* On the attached plan read "turgite" for "hæmatite."

beyond a big crop of siliceous turgite and jasperoid commences. This projects like a wall, 4 to 6 ft. wide, for 2 ch., but towards the south-west, where much silicified limonite (yellow jasperoid) prevails, lode material is found over a width of 40 ft.

Beyond this crop there is a blank of 20 ft., and then boulders of siliceous turgite appear at the surface for 1 ch.; indurated slaty country then shows for 10 ft., when another blow of impure siliceous turgite 1 ch. long is to be seen. At ½ ch. beyond this there is another crop of turgite 20 ft. long and up to 10 ft. wide.

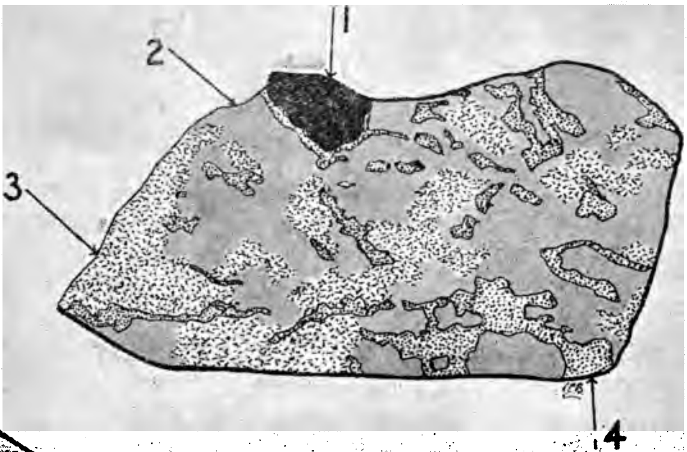


FIG. 8 (DOUBLE NATURAL SIZE).—RICH OXIDISED ORE, NORTH SHAFT, TRUMP.

1. Pyrite veined with limonite
2. Fine grained malachite
3. Crystalline glance
4. Limonite.

The southern trench, alongside this blow on the east, exposes a small bunch of earthy carbonate ore. Another siliceous slightly copper-stained crop is visible just to the east of this trench, and can be followed for 2½ ch. to the south-west.

GEOLOGY.

This is not a fissure lode, but the ore-bodies presumably occur in a crush zone formed during the metamorphism of the whole region as the occurence of the turgite indicates. The copper ores and turgite have no connection beyond that they have both accumulated in a weak zone, and the turgite is therefore not to be expected to change in depth into sulphides. The ore bodies, however, seem to have a lenticular shape and to alternate, but the copper would seem to have been introduced subsequently to the iron masses—for it is found only between and alongside those masses.

Talk o' the Hills (Extended M.C. 333).

Mgr., Pearson.

LOCATION, AREA, ETC.

This lies 5 miles south-east of Hart's Camp, Florence, and ¾ mile north-east of the Trump.

Its area is 200 ft. × 350 ft.

OUTPUT.

1906 ... 1 ton shipped.

ORE-BODY.

There is reported to be here a small leader of very rich ore and 4 ft. poor red ore, similar to that at the Trump (*i.e.*, turgite), on the line of which this claim is believed to lie.

Dandy (P.A. 297).

Mgr., Jackson.

LOCATION, AREA, ETC.

The Dandy is ¾ mile west-south-west of the Trump, and 2 miles south of the Florence River.

Its area is 10 ac.

One shaft 35 ft. deep has been sunk.

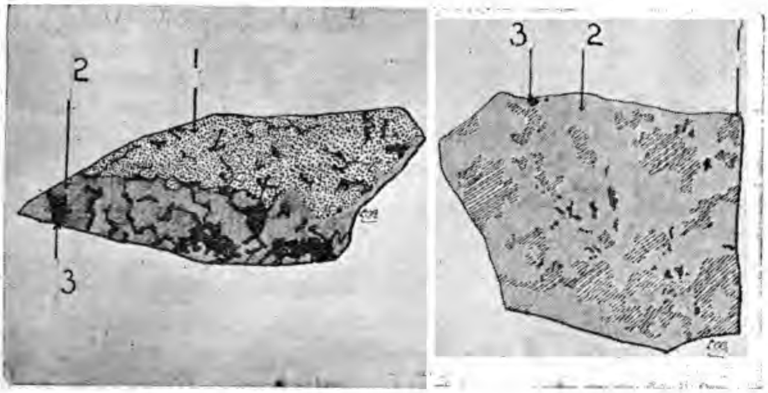
OUTPUT.

1906 ... $6\frac{19}{20}$ tons, 40% ?

ORE DEPOSITS.

The original cupriferous crop was only a few square feet in area, and only silicified limonite can now be seen at the surface, but even of this there is very little. The strike of the body appears to be north-east or north-east-by-east, though there is a small crop some yards to the east-north-east. A separate lens of silicified limonite crops 1 ch. to the north-west of the shaft.

The shaft was sunk in crystalline granular limestone and hæmatite with irregular bodies of copper ore, more especially near the hanging-wall slate, into which they gradually fade. Near the surface the ore (*see* Fig. 9) consisted of siliceous limonite, malachite, chrysocolla (a sky-blue variety, perhaps cyanochalcite), and dense chalcocite, and, together with granular limestone (carrying cuprite) made a body 4 ft. wide. At 6 ft. from the shaft bottom cuprite is associated with ferro-calcite, limonite, and calcite; and the calcite at the bottom carries both cuprite and native copper over a width of 4 ft. The native copper occurs dotted through the ore as small jagged particles (not visibly crystalline), and is always surrounded by cuprite (*see* Fig. 10). There are about 3 tons of silicate ore at grass, which may be expected to carry 10% copper; and 4 tons of the limestone ore (ferro-calcite with nearly one-half cuprite and veins of limonite), probably containing over 40% copper.



FIGS. 9 AND 10 (NATURAL SIZE).—OXIDISED ORE, DANDY.

1. *Fine grained malachite*
2. *Cyanochalcite*
3. *Limonite.*

1. *Calcite*
2. *Cuprite*
3. *Native copper.*

Erin-go-bragh (Extended M.C. 372).

Mgr., Riordan.

LOCATION, AREA, ETC.

This, formerly known as the Alma, lies ½ mile east of the Hampden road, 2 miles north of the Florence River, and 31 miles south of the Cloncurry.

Its area is 800 ft. (?) × 350 ft.

There is one shaft 45 ft. deep.

ORE-BODY.

Unfortunately this claim was not visited, but one of the leaseholders informed me he had a body of silvery glance, 15 in. wide, in the shaft, and that 10 tons of the ore, estimated to carry 45% copper, lay at grass. A specimen of the ore given me consists of almost pure chalcocite, there being only minute specks of the original chalcopyrite and traces of the limonite formed by its oxidation. Stains of malachite and azurite on open cracks are due to recent oxidation of the chalcocite.

OUTPUT.

1905 ...	20	tons shipped,*	40% ore
1906 ...	$6\frac{15}{20}$	,,	,,
Total ...	$26\frac{15}{20}$	,,	,,

---

* Claim then known as the Alma.

MALBON RIVER.

Of the Malbon River groups only the Just-in-Time, on the lower Malbon, was visited. The groups at the head of the river were not visited because of their being deserted during my stay.

The Eastern Malbon is really on a continuation of the Duck Creek belt, the lodes all having an east and west trend. At the Malbon, however, though the outcrops seem to all mark lines of crushing, more persistent perhaps than at Duck Creek, the ore bodies are more limited in size.

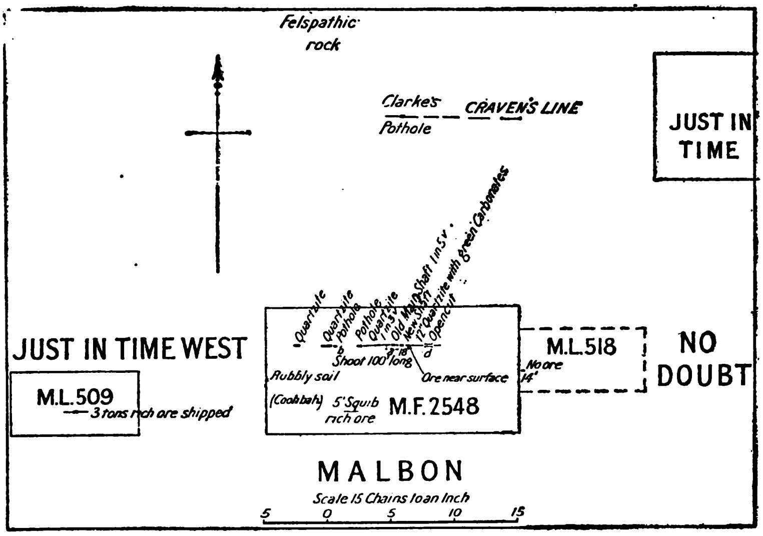
The country is flat, with reddish, sandy soil, or is very slightly rolling, and is then rather gravelly. The only timber is stunted gidia and coolibah (or desert gum).

Output.

The total amount of ore shipped between the beginning of 1901 and the end of 1906 is, according to the available records, 864 tons.

JUST-IN-TIME GROUP.

The Just-in-Time Group is situated on the Malbon River, about 5½ miles above its junction with the Cloncurry River.



Malbon (M.F. 2548).

Location, Area, Etc.

This freehold lies 30 miles south-south-west of Cloncurry, about a mile south of the Malbon River and a mile west of the Devoncourt road. It is often called the Just-in-Time, and is so shown on the map.*

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* G.S.Q. Publication No. 213.

an 18-in. seam of richer ore, 2 tons of which yielded 33% copper, is said to have been cut. About ½ cwt. of this ore at the brace consists of chalcopyrite altering into limonite and in parts almost completely replaced by chalcocite. The ore shown me as from the shaft bottom is limonite with disseminated malachite and small bunches of glance.

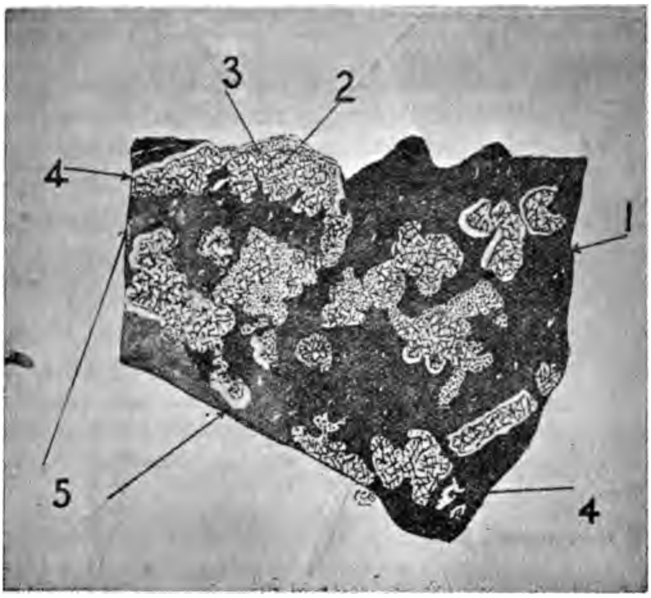


FIG. 6 (NATURAL SIZE).—OXIDISED ORE, M'PHAIL.

1. Limonite.
2. Crystalline malachite
3. Light earthy malachite
4. Chrysocolla (encrusting)
5. Tile ore.

The whole tip at the shaft will probably run over 5% copper, and it contains very little quartz and quartzite. The absence of quartz from the ore paddocks and the high iron contents are conspicuous features at this mine, pointing to the occurrence of dense pyritic ores at a depth.

In connection with the flooded state of the shaft, it is asserted by the lease-holders that the water in the shaft is not affected by the river, although the latter is only a few chains distant, and its bed is but 15 ft. below the brace.

This property would be worthy of development even if there were only the rich bodies cut in the middle trench and in the northern shaft. The gossans here are soft and not likely to make noticeable crops at the surface, wherefore the bodies may yet be proved to have a considerable north and south extension.

Trump (Extd. M.C. 368).

Mgr., McBride.

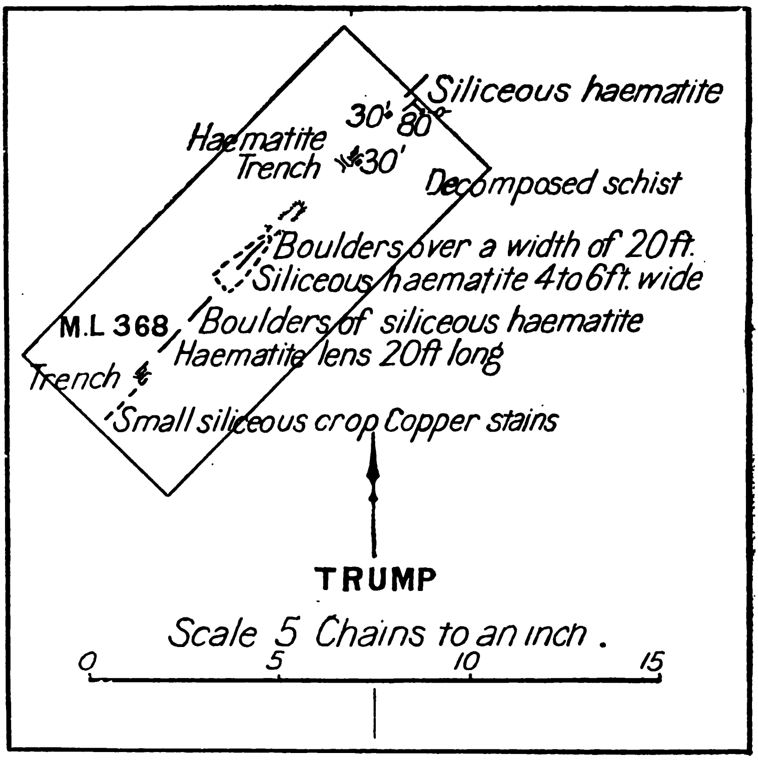
LOCATION, AREA, ETC.

The Trump is about 2 miles south-east of the McPhail.

Its area is 800 ft. × 350 ft.

DEVELOPMENT.

The workings comprise three trenches and two shafts. The northern trench, 1 ch. from the northern boundary, is 20 ft. long and 6 ft. deep; and a costean just to the south is 10 ft. long. The southern trench is 2 ch. from the southern boundary.


Siliceous haematite
30'
80
Haematite
Trench
30'
Decomposed schist
Boulders over a width of 20ft.
Siliceous haematite 4 to 6ft. wide
M.L 368
Boulders of siliceous haematite
Haematite lens 20ft long
Trench
Small siliceous crop Copper stains
0
5
10
15

TRUMP

Scale 5 Chains to an inch.

The northern shaft, 1 ch. south of the northern boundary, is 30 ft. deep.

The second shaft, 15 ft. east of the northern trench, is 30 ft. deep.

OUTPUT.

3 tons shipped, carrying 38½ %

No Doubt (M.L. 518).

Mgr., Allman.

LOCATION, AREA, ETC.

The No Doubt adjoins the Malbon freehold on the east.

Its area is 5 ac. Deserted.

There is one shaft, 14 ft. deep, on the Malbon freehold boundary and 2 ch. south of the freehold line of workings.

No ore-bodies have been exposed.

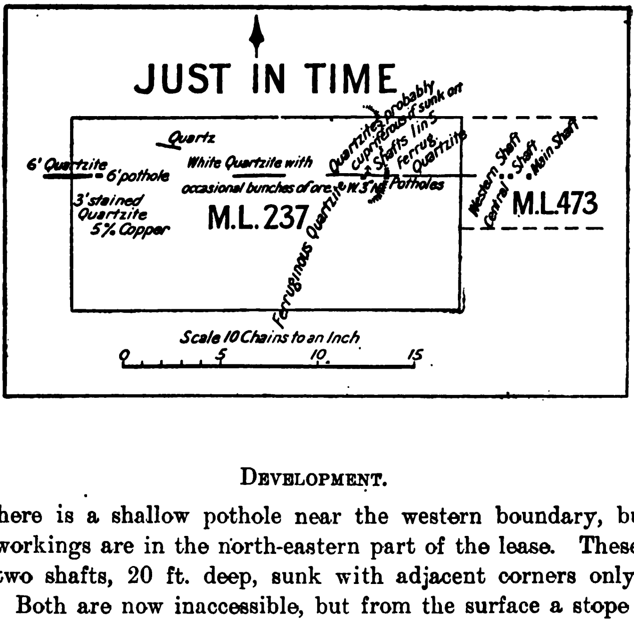
Just-in-Time (M.L. 237).

Mgr., Craven.

LOCATION, AREA, ETC.

The Just-in-Time is about ¼ mile north-east of the Malbon freehold.

Its area is 20 ac. Exempt and idle when visited in December.



DEVELOPMENT.

There is a shallow pothole near the western boundary, but the main workings are in the north-eastern part of the lease. These comprise two shafts, 20 ft. deep, sunk with adjacent corners only 2 ft. apart. Both are now inaccessible, but from the surface a stope 10 ft. wide can be seen, on the southern side of the eastern shaft, and also a 15 ft. drive running westwards from the western shaft, at 15 ft. below the surface.

LITERATURE.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb has tabulated the following analyses (Government Analyst):—

	(c) Country rock.	(r) Rejected from ore raised.
Cu	nil	25·1
SiO_2	57·1	34·2
F_2O_3	13·7	18·1
Al_2O_3	14·4	1·4
CaO	...	trace
S	...	...
	85·2	98·8

OUTPUT.

1901	12 tons	(Freehold ?)	shipped, carrying 37·3% copper
1903	33 ,,	(whole Malbon?)	,,
1904	36 ,,		,,
1906	21 ,,	(Craven and party ?)	,,
	8 ,,		
Total	110 ,,		,,

ORE-BODIES.

Quartzite crops both east and west of the shafts, ironstained but barren in the former case, but containing some bunches of ore for 20 ft. in the latter. At 1 ch. west of the shafts the quartzite becomes very ferruginous, and at 2 ch. distance is worth sinking on in search of copper ore. The body then appears to pinch almost out for two or three chains, beyond which white quartzite with occasional bunches of ore crops out.

On the western boundary there is a quartz blow, 6 ft. wide, at the eastern extremity of which the pothole reveals quartzite stained on cracks with malachite and a little tile-ore, over a width of 3 ft., but containing not more than 5% copper.

The quartzites are reported to crop intermittently for miles to the west.

The north-eastern shaft was sunk on the hanging-wall side (the dip being 5 in 1 to the north), and the south-eastern on the footwall side, of a formation of quartz-veined crushed schist, in which occurred bunches of rich ore. There is about 1 ton of the unsorted ore at grass, chiefly a fine-grained and intimate mixture of malachite, chalcocite, and limonite, with patches of gossany tile-ore; also 3 tons of firsts, which contain, say, 10% silica and probably 35% copper; and 10 tons of very siliceous seconds. Analyses of ore from here are given under Literature. Viewed from the surface this body appears to be worth further opening up.

Development both east and west of this lease would seem to indicate that the ore-bodies on the Just-in-Time line are isolated and of no great size.

Just-in-Time, No. 1 East (M.L. 473).

Mgr., Corney.

LOCATION, AREA, ETC.

This adjoins the Just-in-Time lease on the east.

Its area is 10 ac. Exempt and idle. It was last held by the Cloncurry Prospecting Syndicate.

DEVELOPMENT.

The workings, three shafts, lie about 7 ch. east of the Just-in-Time shafts. The western shaft is 15 ft. deep, was sunk in 1903, and some stoping has been done from it. The central shaft, 56 ft. deep, with drive 40 ft. east at the bottom, is 3 ch. to the east of the western, and the main, or eastern shaft, about 50 ft. deep, is 1 ch. beyond.

OUTPUT.

1905	...	9 tons shipped, carrying 40% copper
1906	...	20 tons ,,
	Total	29 ,,

ORE-BODIES.

The western shaft is in quartzose schist, lenticular bodies of which have been found to be cupriferous.

The central shaft was sunk in similar country. Little ore was got above 53 ft., but in the bottom of the shaft and in the eastern drive there is understood to be a lode, averaging 3 ft. in width, of silver-grey ore, passing downwards into black sulphides. A specimen of the ore given me has a ground mass of chalcocite, through which are distributed very numerous spangles and irregular grains of chalcopyrite, all of which are, however, minutely reticulated by chalcocite. The specimen has one inclusion of pyrite partly altered to limonite, separated from the secondary ore by a thin band of quartz. Fine-grained acicular malachite occurs on cracks in the specimen.

Just-in-Time, No. 2 East (M.L. 388).

Mgr., Craven.

LOCATION, AREA, ETC.

This adjoins the No. 1 East on the east.

Its area is 5 ac. Deserted.

OUTPUT.

1906	...	**10 tons shipped.**

Clarke's (M.C. ?).

LOCATION, ETC.

Clarke's Claim is 15 ch. north of the Malbon freehold and ¼ mile west of the Just-in-Time lease. It was deserted and apparently abandoned in December last.

One shaft has been sunk 15 ft.

OUTPUT.

1 ton shipped.

ORE-BODY.

The shaft was sunk on a bunch of ore in quartzite and crushed schist. Malachite occurs over a width of 6 ft., but the average will not exceed 5%.

The seconds at grass, 3 tons, contain carbonate and oxide, and may run 15% copper, but are very siliceous.

The country to the north-west is felspathic rock, possibly an altered porphyry.

LITERATURE.

For title of report, numbered as below, see Introduction.

(8) The following analyses (Government Analyst) are given in Mr. Gibbs's report:—

(c) Country rock—

Copper	= nil.
Silica	= 57·1
Iron protoxide ...	= 13·7
Alumina	= 14·4
	85·2

(r) Rejected from ore raised—

Copper	= 25·1
Silica	= 34·2
Iron protoxide ...	= 18·1
Alumina	= 1·4
Lime	= tr.
	78·8

Adelaide (M.L. 549).

Mgr., Nathan.

LOCATION, AREA, ETC.

The Adelaide is ¼ mile north of the Just-in-Time lease.

The area is 10 ac. Abandoned.

DEVELOPMENT.

The workings comprise only potholes, trenches, and open cuts. Going from the eastern boundary they are: at 1 ch. an old trench, 40 ft. long, fallen in; after 1½ ch., a trench, 15 ft. long and 6 ft. deep in 12 ft., a pothole, 6 ft. deep; in 10 ft., an open cut, 30 ft. long, 10 ft. wide, and 20 ft. deep, and a 2-ft. trench continued 40 ft. to the east; in 1 ch., a trench, 20 ft. long and 2 to 4 ft. deep; and in ½ ch. a costean.

ORE-BODY.

The ore from the second trench from the east is quartz-veined but carries limonite and malachite, and the contents will run from 10 to 15% copper.

Near the surface, in the open cut, a 2 ft. 6 in. formation, dipping 80° to the south, is exposed, and there is said to be 18 in. solid ore in the bottom beneath the earth fallen in. The manager in December, 1905, reported a lode, 1 ft. to 2 ft. 6 in. wide, of silver-grey ore, assaying 40 to 50%, and the Warden in March, 1906, saw 2 ft. of solid rich ore in the bottom of the cut, 30 ft. from the surface.

In the trench to the west of the open cut there is very siliceous malachite and tile ore, likely to yield 20% copper.

Output.

1904	...	18	tons	shipped		
1905	...	$7\frac{10}{20}$	,,	,,	carrying	32% copper
1906	...	3	,,	,,	,,	35% ,,
		8	,,	stacked		
Total		$36\frac{10}{20}$	tons			

Wheeler's shaft, 25 ft. deep, was sunk about 4 ch. east of the above lease. The prospector got 3 tons of rich red oxide, in a trench at the surface, but little or no ore has been raised from the shaft.

Tower's Boys (Extended M.C. 261).

Mgr., Miller.

Location, Area, Etc.

This lies about 10 ch. east of the Adelaide.

Its area is 1,200 ft. × 350 ft. Abandoned (?)

One shaft is 50 ft. deep, with drives east and west respectively 10 ft. and 12 ft. long.

Ore-body.

The material on the tip is quartz-veined schist, with replacements of tile ore, and stains of green carbonates, but none of it is quite payable.

Telegraph (M.L. 222).

Mgr., Craven.

Location, Area, Etc.

The Telegraph lies 2½ miles north of the Just-in-Time lease, within ½ mile west of the Boulia road.

Its area is 10 ac. It has been exempt for many months.

It was worked during 1902, 1903, 1904, and 1905, but, being deserted, was not inspected by me.

Ore-body.

The ore-body is understood to run east by north.

Output.

1902	...	18	tons		shipped
1904	...	5	tons		,,
1905	...	8	,,	(Wheeler)	,,
		$8\frac{10}{20}$	,,	(Craven)	,,
Total		$39\frac{10}{20}$	,,		

LIMESTONE CREEK GROUP.

This group is on one of the northern tributaries of the river, midway between the Duck Creek and Corella River Groups.

Huggins Look-Out (M.L. 248).

Mgr., Matheson.

LOCATION, ETC.

Huggins Look-out is located on Limestone Creek, an affluent of the Malbon, 30½ miles south-west of Cloncurry.

Its area is 15 ac. The lease is held by the Willcocks Cloncurry Development Syndicate.

The surveyor's plan indicates workings in the northern part of this lease.

ORE-BODIES.

Mr. Cherry, the Warden, in December, 1903, reported that:—"There are three noticeable outcrops. The formation appears to consist largely of a kind of limestone." In February, 1905, he added:—"There appears to be a considerable quantity of ore available of good smelting quality, low grade. . ."

Huggins Look-in (M.L. 249).

Mgr., Matheson.

LOCATION, ETC.

Huggins Look-in is situated 10 ch. east of Huggins Look-out.

Its area is 15 ac. The lease is the property of the Willcocks Development Company.

Two shafts are shown on the surveyor's plan, one near the centre of the northern boundary and the other 4 ch. to the south-west. The company has not reported any work done.

ORE-BODIES.

The survey plan shows outcrops striking north-east in the northern and western part of the lease.

PINDORA GROUP.

The Pindora is the most easterly of the groups at the head of the Malbon.

Pindora (M.L. 295).

Mgr., Donner.

LOCATION, ETC.

The Pindora lies south of the Malbon River, 39 miles south-west-by-west from Cloncurry.

Its area is 10 ac.

ORE-BODIES.

The survey plan shows a quartz crop striking north-east.

Pindora South (M.L. 296).

Mgr., Donner.

Location, Etc.

The Pindora South lies ½ mile south of the Pindora.

Its area is 10 ac.

One shaft is located in the south-western corner of the ground.

Ore-bodies.

The surveyor's plan shows an outcrop running north-north-east, along the western side of the lease.

Bevan Consols (M.L. 519).

Mgr., Bevan.

Location, Etc.

The Bevan Consols is understood to lie 2 miles south of the Pindora.

Its area is 9$\frac{8}{10}$ ac.

MOUNT HOWARD GROUP.

The Mount Howard leases lie to the north-west of the Pindora Group.

Mount Howard (M.L. 569).

Mgr., Williams.

Location, Etc.

Mount Howard is on the northern side of the Malbon River, 40 miles south-west-by-west of Cloncurry.

Its area is 6 ac.

Mount Howard South (M.L. 589).

Mgr., Bevan.

Location, Etc.

This adjoins the Mount Howard on the south.

Its area is 10 ac.

LADY MAUD GROUP.

The Lady Maud lies to the west of the Pindora group. The ground had only lately been secured.

Lady Maud (M.L. 671).

Mgr., Scott.

LOCATION, ETC.

The Lady Maud is on a southern tributary of the Malbon River 4 miles south-west of the Pindora, and 43 miles south-west-by-west from Cloncurry.

Its area is $14\frac{9}{10}$ ac.

Wee Taylor (M L. 707).

LOCATION, ETC.

The Wee Taylor, 2 miles south of the Lady Maud.

Its area is 5 ac.

Lady Harriett (M.L. 722).

LOCATION, ETC.

The Lady Harriett is located $1\frac{1}{4}$ mile south-west of the Wee Taylor.

Its area is 20 ac.

FOUNTAIN SPRING GROUP.

The Fountain Spring Group is located in the range between the heads of the Corella and Malbon Rivers.

Iron Mask (M.L. 529.)

Mgr., Donner.

LOCATION, ETC.

The Iron Mask lies 42 miles west-south-west of Cloncurry.

Its area is 20 ac. It is understood that this lease is held by the Wee MacGregor Company as a flux area.

Iron Crown (M.L. 530).

Mgr., Donner.

LOCATION, ETC.

The Iron Crown adjoins the Iron Mask on the south.

Its area is 20 ac. The ground is held by the Wee MacGregor Company for flux.

Lady Lenore (M.L. 633).

Mgr., Allis.

LOCATION, ETC.

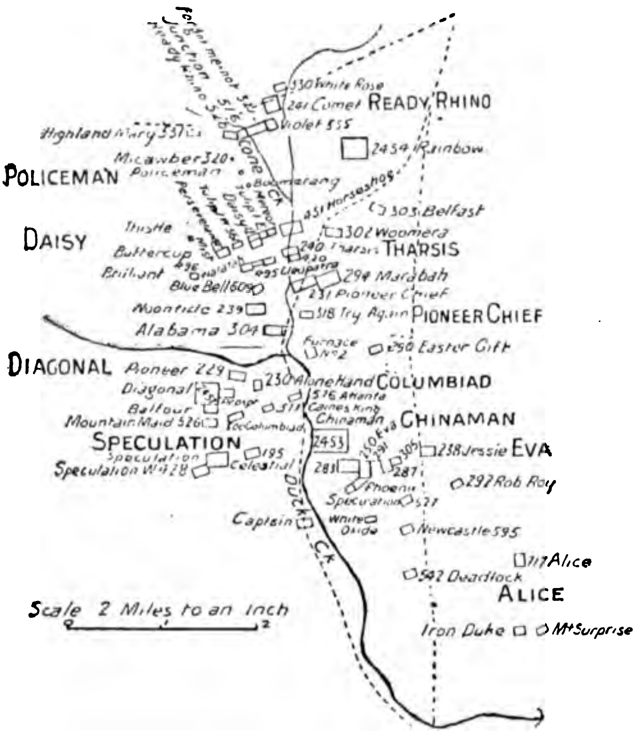
The Lady Lenore is located on one of the eastern tributaries of the Malbon River, 45 miles west-south-west of Cloncurry. It is shown on the map as on a western tributary.

Its area is 5 ac.

DUCK CREEK.

The ore-bodies worked on Duck Creek, Slaty Creek, and the lower Malbon River occur in crush-zones ("formations,"), striking between east-north-east and east-south-east, all others in the Cloncurry district having a general north and south trend. These zones were produced by the yielding of the country along certain lines under the tectonic forces, which induced the schistosity and metamorphism of the whole region, rendering it impossible to detect the original lines of stratification, or even to distinguish between sedimentary and igneous rocks, without microscopical examination.

Many of the quartz crops were at first mistaken for altered sandstones, but my opinion is now that, with few, if any, exceptions, the quartz either segregated from the schists during their metamorphism or has been subsequently introduced.

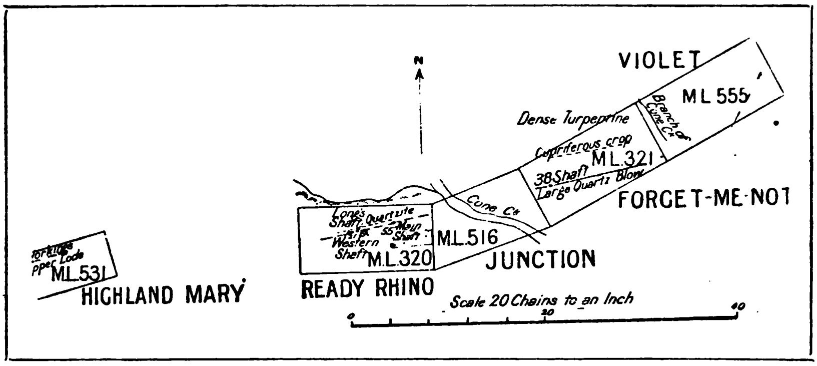


The occurrence of the copper ores is so irregular, and the formations are so variable in width, even within limited areas, that it will be impossible to make any justifiable estimate of the ore available above any level in any of the mines until it has been completely blocked out.

For purposes of location reference is generally made below to the blast furnace on Mount Start at the junction of Cone and Duck Creeks, 23½ miles south-west by west from Cloncurry.

READY RHINO GROUP.

The Ready Rhino group proper includes only the Ready Rhino, Junction, Forget-Me-Not and Violet—the Highland Mary, Coronet and White Rose occurring really on separate crush-zones, and being here included simply because of their geographical position. The last two differ from others on Duck Creek in dipping northwards.



Highland Mary (M.L. 531).

Mgr., Wallace.

LOCATION, ETC.

The Highland Mary lies ¼ mile west of the Ready Rhino, 2¾ miles north-west-by-north of the blast furnace on Mount Start, and 5 ch. south of the Gorge-Corella road.

Its area is 5 ac. The ground was deserted during my stay in the locality.

DEVELOPMENT.

The workings comprise three open-cuts, 1 ch. from, and about half-way along, the northern boundary. The western cut is 18 ft. long and 8 ft. deep; the central, 6 ft. to the east, is 8 ft. long and 6 ft. deep; and the eastern is 12 ft. long and 15 ft. deep. No work had been done since the rain which had fallen two months previously, and the cuts were therefore in a state of collapse. The latest proposal is to sink a shaft to the west of the cuts.

OUTPUT.

1904 ...	4	tons	shipped	by Wallis, carrying 30% copper
1906 ...	3	,,	,,	from the Highland Mary
	10	,,	,,	by Wallace, reported to carry 37 to 39% copper*
Total ...	17	,,	,,	
	$\frac{1}{20}$	,,	at grass	(firsts)
	10	,,	,,	(seconds).

ORE-BODY.

The country here is very flat, and the red soil surface is strewn with quartz fragments, but the Highland Mary ore-body made practically no crop, unlike the Ready Rhino, which passes about 10 ch. to the south. The cuts, however, show the strike to be east 12° north, and the dip 85° to the south-by-east. In the western cut 12 in. width of chrysocolla and gossan is visible, the section between kaolinised slate footwall and granular slate hanging-wall being: gossan and chrysocolla, 12 in.; quartz, 3 in.; and silicified slate, 4 in. In the central cut the lode pinches to 6 in., but in the eastern cut it increases to 15 in. and 18 in. in width, most of which, however, is quartz.

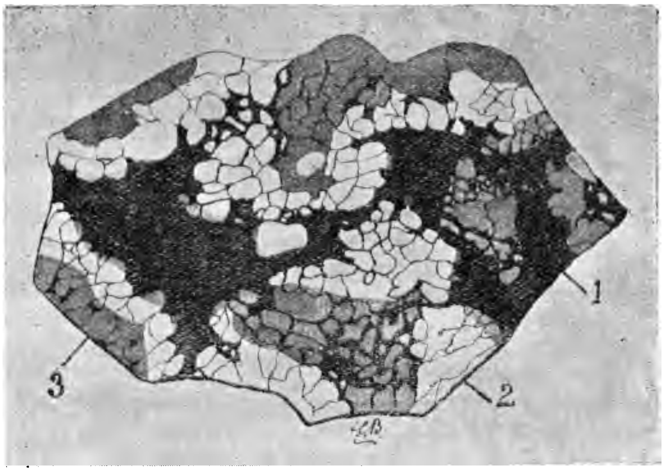


FIG. 11 (NATURAL SIZE).—OXIDISED ORE, HIGHLAND MARY.

1. *Earthy turgite.*
2. *Crypto crystalline malachite.*
3. *Chrysocolla.*

In all, 17 tons of 30 to 39% ore have been shipped from this lease, 1 cwt. at grass being "tesselated ore"—*i.e.*, chalcopyrite in process of alteration into limonite and chalcocite, oxidation having taken place along innumerable intersecting cracks in the original mineral. The seconds at the central cut, bulking 5 tons, consist of quartz and limonite stained by malachite and of black cellular gossan of most promising appearance. The 5 tons seconds at the western cut comprise fragmentary quartz cemented by limonite, and nodules of limonite and earthy turgite with much chrysocolla and malachite, these two minerals in many places fading gradually one into the other. The chrysocolla is typically mammillated in form and, in many parts of the limonite, is also globular. The chrysocolla is more aboundant towards the crust of the nodules, malachite being in excess near the centre, and all stages are exhibited of the replacement of the carbonate by the silicate. Much of the earthy turgite has been porcellanised by deposition of secondary silica and now possesses the same absorptive property as the chrysocolla it encloses. (Fig. 11.)

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* The profit on this is stated to have been £22 per ton, above all expenses except mining.

The state of the workings does not admit of the estimation of available ore, but further development is warranted.

The country rock is more slaty than in most of the Duck Creek mines, having developed only incipient schistosity with comparatively unimportant segregation of quartz. It is greatly weathered and near the ore-body contains much calcareous kaolin. The rock exposed in the western workings may possibly be a highly altered and weathered eruptive. It has a fine micaceous base, in which are set minute crystals of pink orthoclase and lenses of chlorite, the latter thinly coated by granular silica. Amygdaloidal bodies of epidote, surrounded by a thin film of granular silica, are not uncommon and give the rock a volcanic appearance. Similar rock was seen on the Daisy and to the north of the Rainbow freehold.

Ready Rhino (M.L. 320).*

Mgr., Long.

LOCATION, ETC.

The Ready Rhino is located 2½ miles north-north-west of the blast furnace on Mount Start. The main branch of Cone Creek is only 3 ch. to the north-east, and the Gorge-Corella road passes within 10 ch. to the north.

Its area is 10 ac. The lease was being worked by Mr. Jackson for the North Queensland Exploration Company, under an option which extended to December, 1907.

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* Shown on plan incorrectly as 520.

DEVELOPMENT.

The main shaft, which is in the north-eastern part of the lease, is 55 ft. deep, and crosscuts are being opened north and south.*

A second shaft (Long's), 19 ft. deep, lies 4 ch. to the west-by-south, and a third, 21 ft. deep, 30 ft. beyond it. A crosscut is to be opened north from the last. The manager had 5 men at work here in October.

OUTPUT.

1904 ...	4	tons	shipped,	carrying	30 %	copper
	—	"	"			
	—					
Total ...	20	"	"	"	27½ %	copper (*fide* Mr. Jackson)
	—					
	9	"	at grass	"	35 %	"
	9	"	"	"	15 %	"
	6	"	"	"	10 %	"

ORE-BODIES.

The Ready Rhino outcrop strikes east 10° north, dipping steeply south-south-eastwards, and consists, as usual, of schist and quartz, making, however, comparatively little show at the surface. The schist-quartz crush-zone is 8 yds. wide, and the copper ore is found chiefly in bunches along the foot- and hanging-walls. All the work yet done has been on the latter, but the proposed crosscuts are intended to prove any ore-bodies on the former at a depth. The crop does not appear in the vicinity of the lease to the west, but is in evidence about 10 ch. south of the Highland Mary workings. It has been traced through the Junction and Forget-Me-Not on the east.

The main shaft is in a formation of crushed schist and quartz, cupriferous to a depth of 22 ft., where occurs a parting dipping 45° to the south-east, below which the formation is barren of copper.† There are at grass 9 tons of 35% ore, comprising dense limonite, malachite and glance in kaolinised schist, and 9 tons of 15% ore (seconds), in which the copper is present chiefly as carbonate and to a less extent as oxide.

Long's shaft exposes a nearly vertical body, 4 ft. wide, of cupriferous kaolinised schist, with lenticular masses of granular quartz. Some 15 or 20 tons of 27½% ore have been shipped from here. The seconds remaining amount to 6 tons and consist of quartz with limonite, malachite and a little chalcocite, the average content being 10% copper.

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* The manager reported Jan 29, '07:

"The straight shaft on the Ready Rhino has been sunk to a total depth 80 ft. from the surface. The water is very heavy and labour [consequently] hard to obtain. We have start-d to open out at 70 ft., which is water level. . . . Since starting to crosscut a distance of 16 ft. has been driven."

† The manager reported (29th Jan. '07) that in the crosscut on the 70 ft. level: "We passed through the lode, which is 3 ft. 6 in. in width. We are now driving on the lode east and west. In the east drive the ore body measures 5 ft. and assays in bulk 9%. In the west drive it is 3 ft. thick and assays 3·25 % copper."

Junction (M.L. 516).

Mgr., Jackson.

LOCATION, ETC.

The Junction adjoins the Ready Rhino on the east, and is crossed from north-west to south-east by Cone Creek.

Its area is 7 ac. The lease is held by the North Queensland Exploration Company, which had not yet begun operations when it was visited by me.

Forget-Me-Not (M.L. 321).

Mgr., Long.

LOCATION, ETC.

The Forget-Me-Not adjoins the Junction on the east, and lies between the main and eastern branch of Cone Creek.

Its area is 10 ac. The lease is being worked under option by Mr. Jackson for the North Queensland Exploration Company.

DEVELOPMENT.

The shaft, which is 2 ch. from the western boundary, has been sunk 38 ft., and a crosscut is now being opened on the southern side. Two men are working here.

ORE-BODIES.

The Ready Rhino formation appears on this lease as a large crop, traceable to the eastern boundary, of crushed schist and lenticular masses of quartz, with interstitial bunches of copper ore.

The shaft has been sunk on a copper-bearing band of country on the southern side of the blow. Bunches of copper ore were found to a depth of 20 ft., where was pierced a body of chalcocite, containing quartz crystals, the whole 18 in. thick, and dipping 3 in 1 h. to the south, but below the formation is barren of copper and free from iron. The copper-bearing country is expected to be reached in the southern crosscut within 6 ft.

Another parallel crop, lying 3 ch. to the north, shows 1 to 5 ft. of quartz, with fairly strong iron stains and frequent bunches of copper ore over the whole length of the lease. In appearance it is more promising than the main crop, but no work has yet been done here.

Violet (M.L. 555).

Mgrs., Long and Jones.

LOCATION, ETC.

The Violet adjoins the Forget-Me-Not on the east.

Its area is 10 ac. The lease had been only lately applied for, and no work had been done in October last.

Coronet (M.C. 241).

Mgr., White.

LOCATION, ETC.

The Coronet (or Cornet) lies, on a branch of Cone Creek, 2¾ miles north of the blast furnace on Mount Start, and only a few chains north of the Violet. The Gorge-Corella road passes across the northern part of the lease.

Its area is 20 ac. and, unlike most others, the lease is square. The ground was deserted during my stay in the locality last October, but is understood to be the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

Two holes, 30 ft. apart, have been sunk here: a western, 6 ft. deep, and an eastern, 10 ft. deep and 20 ft. long. They are 4½ ch. south-west of the north-eastern corner.

OUTPUT.

1904 ... 22 tons were shipped by I. White (but the source is doubtful).

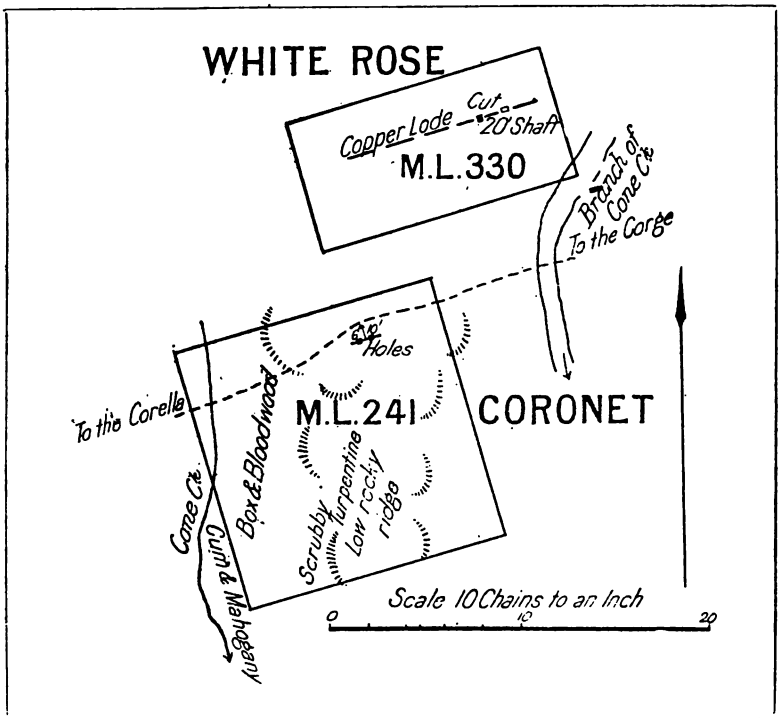
ORE-BODIES.

The crop at the workings strikes east 12° north and dips 3 in 1 h. to the north-by-west, almost the sole case of a northerly dip noticed on Cone Creek. It is 2 ch. in length, and up to 10 ft. wide, and consists of quartz much stained by limonite.

The western hole exposes barren quartz, 20 in. wide, adjacent to the hanging-wall; then quartz, much of it crystallised and cemented by cupriferous limonite, 18 in. wide; formation, 9 in. wide; and quartz, 4 ft. wide, adjacent to the footwall. The country is chloritic schist. Some very fair bunches of malachite and tile-ore have been raised from this hole.

The eastern cut having caved in, little can be seen. The quartz from the cut is more cellular and iron-stained than any of the more

southerly crops, and some very cellular gossan has been found, giving encouragement for further sinking.



White Rose (M.L. 330).

Mgr., Allis.

LOCATION, ETC.

The White Rose lies 3 ch. north of the Coronet.

Its area is 10 ac. It had apparently been long idle when visited in October last. The lease has now been taken over on option by the West Cloncurry Copper, Limited.

DEVELOPMENT.

The workings consist of an opencut, 3 ch. from the eastern boundary; and of an inaccessible shaft, 20 ft. deep, 1½ ch. further west.

OUTPUT.

1906	... 11 tons	of ore shipped.

ORE-BODY.

The White Rose crop strikes east 15° north, and its dip is north-north-westwards.

The opencut exposes promising cupriferous formation, and the shaft has been sunk in ferruginous quartzite and schist, cemented, where jointed or crushed by malachite and limonite, the total width of the formation here being 5 ft. The seconds at grass amount to 6 tons and consist of quartz and schist cemented by malachite and limonite, with a little tile ore, the copper content approximating to 15%, and the silica content, at the same time, being very high.

Abandoned (M.L. ?).

LOCATION, ETC.

This old holding lies ½ mile east of the White Rose, and a few chains north of the Gorge-Corella road.

Its area is not known, all attempts to find either the name or the number of the lease having failed. The ground was deserted during my stay in the locality, and had apparently been long idle.

DEVELOPMENT.

The workings consist of an opencut, 40 ft. long and 4 ft. deep, in the central part of which is an underhand stope, 18 ft. long and 8 ft. deep. A shaft sunk from the bottom of the stope has now caved in.

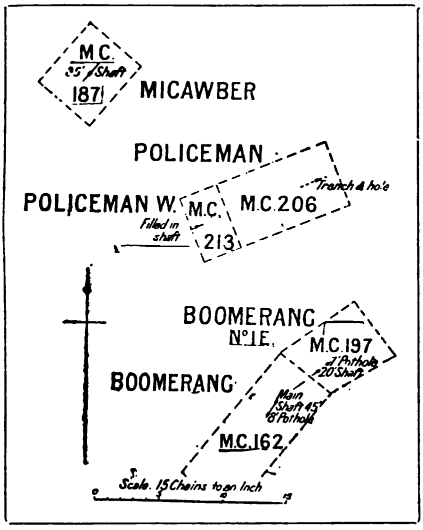
ORE-BODIES.

The formation worked is believed to be on the line of the White Rose, here also dipping northwards. The country rock is a dense black slate, softened and bleached near the ore, where also slightly schistose, the walls of the ore-body being well defined but showing no sign of extensive movement. The faces of the workings exhibit a formation 9 in. to 12 in. wide and consisting of quartz, limonite, bornite and chalcopyrite, the first traces of the last being found within 6 ft. of the surface. The bornite, which has an iridescent purplish tint, is here massive, occurring as irregular bunches and veins both in granular quartz and crystalline calcite. The magnifying glass proves that it represents enriched chalcopyrite, though the inclusions of that mineral are seldom tesselated, and when they are the reticulating veinlets are always of limonite. In other ore-bodies on the Cloncurry fields, where chalcocite is the secondary mineral, the enclosed pyrite always exhibits a netting of the sulphide. Ore has been shipped from here, and 2 tons of very siliceous seconds remain at grass, the copper being present as bornite in limonite, with some stains of malachite. Ferruginous calcite is also present in some quantity in the heap of seconds.

In the present state of development it cannot be said that there is any ore in sight, but the faces warrant further opening up.

BOOMERANG GROUP.

The Boomerang Group includes four disconnected crops—the Boomerang, Policeman and Micawber, and Rainbow, not of any importance except in showing the frequency of crush-zone on Cone Creek.



Boomerang (M.C. 162).

Mgr., Holt.

Location, Etc.

The Boomerang is located on the western side of Cone Creek, ½ mile north of the Daisy, and 2 miles north-north-west of the blast furnace on Mount Start.

Its area is 800 ft. x 350 ft. It was deserted when inspected, having been under exemption for a short time.

Development.

The main shaft, 45 ft. deep, is on the western side of the Cone Creek dray track; and from it a drive runs east for 10 ft. at 25 ft. below the surface. A second hole, 8 ft. deep, lies 1 ch. to the south-west-by-west.

Output.

		4 tons	shipped			
1906	...	2 ,,	,,	carrying	35 %	copper
		1 ton	at grass	,,	35 %	,,
		20 ,,	,,	,,	10 %	,,

Ore-bodies.

A crop of granular barren quartz and cupriferous schist, 5 ft. in width, runs south 35° west and east 38° north from the main shaft, in which can be seen only lumps of quartz and copper-stained schist, though a 3 ft. bunch of 30 % ore was found at 13 ft. depth. About 2 tons of 35 % ore has been shipped from the main shaft, and 1 ton, estimated to carry between 30 % and 40 % copper, is now in the paddock. This ore consists of intimately associated chalcocite and limonite stained by malachite. The seconds, amounting to 20 tons and averaging 10 % copper comprise malachite, chalcocite, and a little azurite, chiefly in schist with not a large amount of quartz.

Boomerang 1 East (M.C. 197).

Mgr., Blosson.

LOCATION, ETC.

This claim adjoins the Boomerang on the north-east.

Its area is 400 ft. x 350 ft. It was deserted when visited in October last.

DEVELOPMENT.

Two shafts have been sunk: one, 20 ft. deep, lies 4 ch. north-east-by-east from the Boomerang main shaft; and the other, 7 ft. deep, about a chain beyond.

ORE-BODIES.

The Boomerang formation strikes east 38° north in this claim. In the deeper shaft it consists of kaolinised schist quartz and gossan, with very little copper ore near the surface, though promising in appearance. The shallow shaft exposes schist with much quartz, and about 1 ton of 10 % ore (malachite-bearing schist) has been raised from it.

Policeman (M.C. 206).

Mgr., Moran.

LOCATION, ETC.

The Policeman lies 10 ch. north of the Boomerang.

Its area is 600 ft. by 350 ft. No one was present on the ground when it was inspected in October last, though ore had lately been bagged. This ground has also been held under the title of the Shamrock.

A trench 20 ft. long and 5 ft. deep, with a hole 5 ft. deep in one end, has lately been opened, ¼ mile north-north-east of the Boomerang.

ORE-BODIES.

The Policeman outcrop strikes east 28° north, and the greater part of it is, as usual, crushed schist with lenticular veins of quartz, the adjacent country being altered slate, only slightly schistose. The trench affords an exposure of a character different to all others seen on Cone Creek, except perhaps the Belfast, though possessing some similarity to those in the Slaty Creek catchment area to the north There is here a vein 18 in. to 2 ft. 6 in. in width of jointed quartz and dark reddish ferro-calcite, with much fine grained, granular hæmatite and some chrysocolla. The richer ore consists of an intergrowth of chalcocite and tile ore, and of chalcocite and chalcopyrite, the last mineral being found more especially impregnating the cherty silicified ore, in which silica appears to have replaced limonite. About 4 tons of firsts running 20 % copper have been paddocked.

Policeman West (M.C. 213).

Mgr., Brady.

LOCATION, ETC.

This adjoins the Policeman on the west, the workings on the two claims being 10 ch. apart.

Its area is 200 ft. x 350 ft. The ground appears to be abandoned.

A shaft has been sunk alongside the Cone Creek track, but has been filled in again to within 6 ft. of the surface.

OUTPUT.

1905 ... 9 tons shipped by Brady and Allis.

ORE-BODY.

The Policeman crop here strikes east 28° north. At the shaft there is a small lenticular body of quartz, and the chloritic schist adjacent to it is stained by malachite and iron oxides.

Micawber (M.C. 187).

Mgr., Osborne.

LOCATION, ETC.

The Micawber lies 10 ch. north-west of the Policeman, and about 15 ch. south of the Ready Rhino.

Its area is 400 ft. x 350 ft. The claim was under exemption when visited because of the ore in sight being unpayable.

DEVELOPMENT.

One shaft has been sunk between 35 and 40 ft., underlying steeply towards the south-east near the bottom.

OUTPUT.

1906	..	1 ton	shipped	carrying 24 %	copper
		20 ,,	at grass	,, 5 %	,,

ORE-BODIES.

The Micawber crop strikes north 40° east, and underlies steeply to the south-east. It consists of granular quartz, much resembling quartzite, and to the south-west of the shaft it is 4 ft. wide. The greater part of the material raised is quartz, only 2 tons of export quality ore having been obtained. The seconds, amounting to 20 tons, are very siliceous, and carry not more than 5 % copper, as malachite, chiefly, though a little chrysocolla and chalcocite are present also.

Rainbow (M.L. 2454).

LOCATION, ETC.

The Rainbow is situated just to the west of a short range, 2½ miles north by east from the blast furnace on Mount Start and about a mile west of the Cloncurry-Duck Creek road.

Its area is 40 ac. It was deserted last year, but has lately passed into the hands of the Queensland Copper Freeholds, Ltd.

LITERATURE.

For titles of reports, numbered as below, see Introduction.

(2.) Mr. Jack's report is:

> *The Rainbow Lode* (marked "2454" on the map) lies about three and a-half miles to the south of Selection No. IX., on the fall of Cone Creek, a tributary of Duck Creek. It occurs in flat country, and shows a "blow" (striking WSW. and underlying to SSE.) of green carbonate of copper and gossan. A shaft has been sunk to the depth of 25 feet. The ore now lying at grass came from the bottom of the shaft, and is of very good quality—red oxide and green carbonate of copper (the latter enclosing quartz crystals), and silver-grey copper ore (sulphide of copper and antimony). The lode is traced for over 100 yards. At its west end it is crossed by a quartz reef running NW. and SE., and showing some red oxide of copper and some grey sulphide of copper and antimony. I consider the Rainbow quite a payable mine.

(7.) Mr. Rutherford says:

> This consists of an irregular quartz outcrop in schist running east and west for a considerable distance. Associated with the quartz, especially at the eastern end, are green carbonate of copper and iron oxide. A shallow shaft shows that the quartz does not continue in depth. Some good ore is said to have been sent away from the surface diggings.

DEVELOPMENT.

Only one shaft, 20 ft. deep, was seen here.

ORE-BODY.

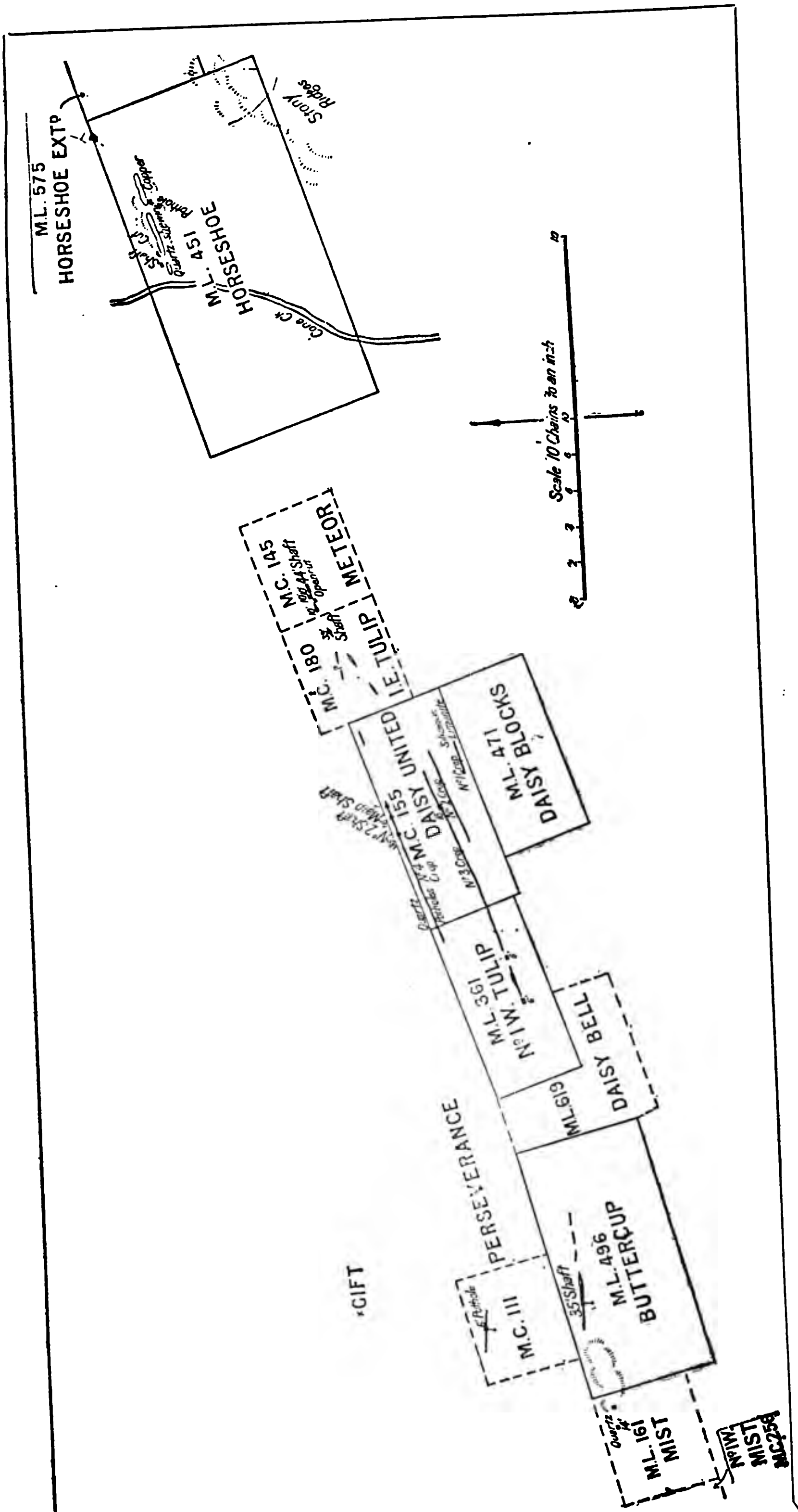
The Rainbow ore-body, which is in altered slate country, strikes east 20° south, and dips 70° to the south-south-west.

At the shaft it has a width of from 6 in. to 2 ft., and consists of strongly ironstained quartz, with cellular gossan and traces of malachite. Lumps of medium quality ore have been found on the surface for several chains to the east, and warrant further development.

A short distance to the north of the Rainbow an amygdaloidal rock similar to that found on the Daisy and Highland Mary was noted to occur in great quantity.

DAISY GROUP.

On the Daisy crush-zone there are only the Horseshoe, Meteor, Tulip East, Daisy United, Tulip West, Buttercup, Mist and Mist West; but the Woomera, Perseverance, Gift and Thistle are taken in the group because of their proximity to the main line.


M.L. 575
HORSESHOE EXTD
M.L. 451
HORSESHOE
Stony Ridges
Quartz, Stone & Copper
Pothole
Cone Ck
Scale 10 Chains to an inch
M.C. 145
No. 4 & 4 Shaft
Open cut
METEOR
M.C. 180
Shaft
I.E. TULIP
M.C. 155
DAISY UNITED
No. 2 Shaft
Main Shaft
Quartz
Pothole
Cup
No. 4 Cap
No. 3 Cap
No. 2 Cap
No. 1 Cap
M.L. 471
DAISY BLOCKS
M.L. 361
No. 1 W. TULIP
M.L. 619
DAISY BELL
PERSEVERANCE
M.L. 496
BUTTERCUP
35' Shaft
M.C. 111
Pothole
GIFT
Quartz
M.L. 161
MIST
No. 1 W.
MIST
M.C. 256

Woomera (M.L. 302).

Mgr., Matheson.

Location, Etc.

The Woomera lies 1¼ mile north-by-east of the blast furnace on Mount Start, just to the east of the Cloncurry-Duck Creek road.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate.

One shaft has been sunk in the north-eastern corner of the lease, but is now inaccessible.

Ore-body.

The ore-body is believed to strike east and west.

Horseshoe (M.L. 451).

Mgr., Corney.

Location, Etc.

The Horseshoe lies 1¼ miles north of the blast furnace on Mount Start. Cone Creek traverses it from north to south.

Its area is 20 ac. It was under exemption and deserted when visited in October last. The Celestial Copper and Option Company, Ltd., is understood to have since taken it over. The ground was formerly held as a claim and known as the Big Ben.

Development.

A shaft, now full of water, has been sunk 45 ft., at about 1 ch. east of the creek; 2½ ch. to the east-north-east is a small cut; and 1½ ch. to the east of the cut is a pothole, 5 ft. deep. There are also a few old trenches and potholes east again of this.

Output.

1905 ...	5 tons	shipped	by Byrnes and Co.	
1906 ...	14 „	„	„	„
Total ...	19 „	„		

Ore-bodies.

The Horseshoe crop strikes east-north-east and has some resemblance to the Tharsis, than which, however, it is much poorer. On the west copper and ironstained schist, with numerous overlapping parallel lenticular quartz veins underlying southwards, crop within ½ ch. of the creek. The shaft was sunk in country on the northern side of this part of the crop, and disclosed very little ore. Some of that raised shows quartz fragments set in fine grained crystalline hæmatite, which is slightly impregnated by malachite and seamed by thin films of limonite. A crosscut should therefore be opened southwards from it.

The quartz-veined schist crop continued to the east-north-east for 7 ch., increasing from 20 ft. to 40 ft. in width. Within this area there are two specially prominent crops of quartz, one, 2½ ch. long and 10 ft. wide, beginning 1½ ch. east of Cone Creek, and the other, 2 ch. long and 6 to 8 ft. wide, lying ½ ch. to the east of the first. The former stands out 5 ft. above the schists, and the latter rises 10 ft. above the surrounding flats.

The quartz as usual is practically barren, but occasional bunches of poor ore are found in the adjacent and interlaminated schists, as at the central cut. The eastern pothole exposes only slightly copper-stained schist.

Meteor (M.C. 145).

Mgr., Absolon.

LOCATION, ETC.

The Meteor adjoins the Horseshoe at the north-western corner, and lies ¼ mile north of the Cleopatra.

The area is 400 ft. x 350 ft. The claim was deserted when visited in October.

DEVELOPMENT.

The main shaft, which is 44 ft. deep and underlies 4 in 1 h., is 2 ch. from the western boundary; at 20 ft., 40 ft. and 1½ ch. distance to the west there are potholes, each 10 ft. deep; and an opencut lies 30 ft. east of the last. Sinking in the main shaft is said to have ceased because of the water met with.

OUTPUT.

1904 ...	8 tons	shipped	by Boyd
1905 ...	15 ,,	,,	,, Hardess and Boyd.
Total ...	23* ,,	,,	
	5 ,,	at grass	seconds
	70 ,,	,,	carrying 10 % copper.

ORE-BODIES.

The crop in this claim, part of the Horseshoe-Daisy-Buttercup line, strikes east 20° north underlying 4 in 1 h. to the south, and comprises 10 ft. width of quartz, with included copper-stained and ferruginous schist.

It is understood that copper ore was found in the shaft from the surface to the water-level, which is at the bottom. The ore last raised is quartz-bearing chloritic schist with veins and octahedral crystals† of cupriferous pyrite; and of this there is about 5 tons at grass. The claim-holders are reported to have shipped 4 tons of 25 to 30 % ore (chalcocite and malachite) and tributers 1 ton more of similar quality.

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* Reported total 60 tons shipped, containing 25 to 30 % copper.

† Sometimes modified by the development of cube faces.

The second pothole to the west is on a small pocket of ore.

The westernmost hole was opened on a body of secondary sulphides 18 in. wide, which apparently has not proved of any extent. There are 70 tons of seconds at grass, which should yield 10 % copper.

Tulip No. 1 East (M.C. 180).

Mgr., Leonard.

LOCATION, ETC.

This adjoins the Daisy United on the east.

Its area is 400 ft. by 350 ft. Deserted.

DEVELOPMENT.

One shaft has been sunk, a few chains west of the Meteor workings. It is 39 ft. deep, and has a 40-ft. crosscut north at the bottom, now inaccessible. It had lately been let on tribute.

ORE-BODIES.

Three crops occur in this claim on a line running west 35° south, making an acute angle with the Daisy-Meteor line. The crops consist of quartz and chloritic schist, with abundant granules of limonite in the cupriferous parts, as well as a little actinolite.

A great quantity of quartz was met in sinking the shaft, and the copper content was not above 10 %; but in the crosscut there is reported to be 5 ft. 6 in. of granular quartz, replacing schist and impregnated with malachite, copper being present to the extent of 18 % —these figures presumably being maxima. The tributers failed to secure any shipping ore—20 % or over.

Daisy United (M.C. 155).

Mgr., Grey.

LOCATION, ETC.

The Daisy United lies between the Tulip No. 1 East and the Tulip No. 1 West, 1½ miles north-north-west of the blast furnace on Mount Start.

Its area is 800 ft. by 350 ft., and it includes the two old claims known as the Daisy and Tulip.

DEVELOPMENT.

One vertical shaft (*a*), 6 ft. x 5 ft. and 18 ft. deep, is located near the centre of the claim.

Three other shafts lie near the middle of the northern boundary, where work is now in progress. The main underlie shaft, 9 ft. x 6 ft., is 78 ft. deep, with stope extending back for 10 ft. from the shaft, between 30 ft. and 50 ft. from the surface; No. 2 underlie shaft, 35 ft. deep, is 1 ch. to the west-north-west and has drives 15 ft. east and west; and a pothole, 7 ft. deep, is 20 ft. to the east-north-east.

OUTPUT.

1905 ...	4 tons	shipped	
1906 ...	35 „	„ *	
	27 „	„	by Grey and Long
Total ...	66 „	„ †	
	100 „	at grass,	seconds carrying 15 % copper.

ORE-BODIES.

Four parallel outcrops, striking east 20° north, have been found on this claim. No. 1, near the southern boundary and 3 ch. from the south-eastern corner, consists of siliceous limonite, on which no work has yet been done.

No. 2 crop, which is visible for several chains, but is as yet untouched, lies 1½ ch. to the north, and comprises 2 ft. width of quartz and some copper ore.

No. 3 crop is 50 ft. to the north of No. 2, and can be traced through the greater part of the Daisy United into the Tulip West. At the shaft (*a*) is a vein of quartz 3 ft. wide, dipping 80° to the south-south-east in chloritic schist. The quartz has been found to carry a little gold. Bunches of rich but siliceous malachite and cuprite were found in sinking the shaft, but in all only 3 tons, carrying 33½% copper, have been shipped, and the 5% seconds at grass amount to but 1 cwt.

No. 4 crop dips 10 in 1 to the south-south-east. At the surface of the main shaft the formation is 4 ft. wide; at 40 ft. below, it pinches to 3 ft. width; but at 70 ft. below, the lowest accessible, it is 9 ft.; and, in the bottom, is stated to be 12 ft. The walls are well marked and the hanging-wall exhibits occasional horizontal slickensides. Malachite and tile-ore showed at the surface, but below in the shaft much chalcopyrite, intricately veined by chalcocite and assaying up to 45% copper, has been found. Near the bottom, which is believed to be just above the water-level, bunches of powdery secondary sulphides occur in the schists, together with elongated octahedral crystals of pyrite, on each side of a horse of quartz, which came in at 45 ft. below the surface. Of the total width at 70 ft depth 7 ft. consists of quartz, all of which has to be raised. The section exposed in the ends of the shaft is as follows: Adjacent to the footwall 12 in. chalcopyrite and chalcocite bearing formation; 5 ft. quartz with bunches of chalcocite and also of chlorite; 2 ft. quartz with a larger proportion of chalcocite; and 12 in. quartzose formation carrying chalcocite, adjacent to the hanging-wall. In all 80 tons of firsts, assaying from 27 to 35½% copper, have been separated, and 100 tons of seconds, averaging 15% copper, are paddocked at the shaft. The clear profit to the claim-holders over all expenses, except mining, has, with copper at £80 per ton, amounted to £16 per ton of ore shipped.

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* One parcel of 20 tons ran 33 %, and yielded a profit of £11 clear of expenses.

† Mr. Gray informed me that a total of 8¼ tons had been shipped, carrying 27 to 35½ % copper.

The exposures in No. 2 shaft much resemble the above, there being a central body of poor quartz, 3 ft. thick and dipping 5 in 1 h. to the south-south-east, with 3 ft. width of cupriferous formation on the south, and 18 in. width on the north, but much earthy calcareous sinter (locally known as kaline) has been deposited here in the ore-body as well as in the hanging-wall country.

Malachite and tile-ore were got in the upper part of the shaft, but metallic chalcocite (glance) and chalcopyrite are coming in towards the bottom. The western drive is in the hanging-wall formation, which here consists of chloritic schist, strongly impregnated over the whole width of the drive with malachite and glance. The eastern drive is in much more siliceous ore, though just above it in the shaft there is 2 ft. 6 in. width of bagging ore.

The country rock exposed in the workings is schist, but there are several outcrops in the southern part of the claim of a highly metamorphosed slaty rock. This has a fine-grained siliceous base of neutral tint, and scattered through it are spheres ⅛-in. in diameter, of radiating, greenish actinolite, irregularly shaped grains, up to ¼-in. in diameter, of calcite, and small bundles of yellow epidote needles, more especially in or near the calcite.

Daisy Block South (M.L. 471).

LOCATION, ETC.

This adjoins the Daisy United on the south.

Its area is 5 ac. Work has not yet begun here.

Tulip No. 1 West (M.L. 361).

Mgr., Leonard.

LOCATION, ETC.

This adjoins the Daisy United on the west.

Its area is 5 ac. It was exempt and deserted when visited, and the lease has been held for 2 yrs.

DEVELOPMENT.

The workings comprised two shafts, each 6 ft. deep, at 3 and 5½ ch. respectively from the eastern boundary.

OUTPUT.

$\frac{15}{20}$ tons shipped, containing 40 % copper.

ORE-BODIES.

The No. 3 line of the Daisy United makes several small crops in this lease, and between these the potholes have been opened. The ore now visible is rubbly, and very low in grade.

Daisy Bell (M.L. 619).

Mgr., Connell.

LOCATION, ETC.

The Daisy Bell includes ground left between the Tulip No. 1 West and the Buttercup.

Its area is 4 ac.

One hole has been sunk 6 ft. in rubble.

Buttercup (M.L. 496).

Mgr., Jones.

LOCATION, ETC.

The Buttercup lies 15 ch. west-south-west of the Daisy.

Its area is 9$\frac{8}{10}$ ac. It was let under tribute at the time of my visit.

DEVELOPMENT.

The shaft is 5 ch. east of the north-western corner peg. It is 35 ft. deep, and has drives 20 ft. and 15 ft. to the east and west respectively, at the 30 ft. level, a stope above the latter extending to the surface. Work is now in progress here.

OUTPUT.

1906 ...	4 tons	shipped	from Buttercup
Total ...	4 ,,	,, *	
	30 ,,	at grass,	carrying 12 % copper.

ORE-BODIES.

A formation, presumably one of the southern Daisy lines, here striking east and west, is being tested on this lease. The shaft lies on

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* It is reported that 20 tons of 25 % ore have been shipped, one parcel of 3 tons of 23¾ % ores despatched to South Australia in May, 1906, yielding a profit of £7 per ton, clear of all expense, except mining.

the line of strike of the Daisy main northern zone, which, however, is believed to have bent round and to run 5 ch. to the north of the Buttercup. The formation is schist and quartz, containing bunches and stains of tile-ore, cuprite, and malachite, veined in the lower part of the shaft with glance. In the western drive the rich ore has gradually decreased in quantity, that over 3 ft. width in the face being worth not more than 10% copper, but at the same time being comparatively low in silica. In the face of the eastern drive is exposed: 6 in. copper-stained quartz on the footwall; then, 12 in. schist rich in malachite, cuprite and glance; and then 3 ft. of copper-stained quartz. Some small octahedral crystals of limonite (pseudo-morphous after pyrite ?) were noticed in the richer ore.

The seconds at grass amount to 30 tons and are expected to run from 12 to 15% copper.

The country rock is schist, the footwall in places being slickensided, unlike the hanging-wall, which, however, is well defined. The dip, as all along the line, is to the south.

Mist (M.C. 161).

Mgr., Brady.

LOCATION, ETC.

The Mist adjoins the Buttercup on the west.

Its area is 200 ft. x 350 ft. The ground was unmanned when inspected.

DEVELOPMENT.

The workings comprise a pothole and a 14 ft. shaft, ½ ch. and 1½ ch. respectively west of the Buttercup boundary.

ORE-BODIES.

There is here a crop 6 ft. wide of quartz, seamed with gossan, and in the shaft both tile-ore and malachite have been found.

Mist No. 1 West (M.C. 256).

Mgr., Brady.

LOCATION, ETC.

This adjoins the Mist on the west.

Its area is 200 ft. x 350 ft.

Perseverance (M.C. 111).

Mgr., Church.

LOCATION, ETC.

The Perseverance adjoins the Buttercup on the north.

Its area is 400 ft. x 350 ft. It was deserted in October, and apparently abandoned.

Only one pothole, 6 ft. deep, has been opened—between 5 and 6 ch. north of the Buttercup shaft.

ORE-BODY.

A siliceous crop, 5 ft. thick and 3 ch. long here strikes east and west and is believed to be on the northern crush-zone of the Daisy. The patch of gossan opened is poor in copper, but its apearance warrants some further work here.

LITERATURE.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb gives the following analysis of ore from the Perseverance (Iron Cross Course), Duck Creek (Government Analyst):—

Copper	=	6·7 %
Silica	=	17·0 %
Iron protoxide	=	61·7 %
Alumina	=	2·6 %
Lime	=	trace
		88·0 %

Gift (M.C. 194).

Mgr., Brady.

LOCATION, ETC.

The Gift lies about 12 ch. north of the Buttercup.

Its area is 200 ft. by 350 ft. It was deserted when inspected.

DEVELOPMENT.

One shaft has been sunk 30 ft.

OUTPUT.

30 tons shipped, carrying 40 % copper.

Unknown (M.C. ?).

Mgr., Dally.

Location, Etc.

This lies about 7 ch. west of the Gift, and 12 ch. north of the Mist.

The claim being deserted, its area could not be ascertained.

A hole has been sunk 7 ft.

Output.

$\frac{18}{20}$ ton shipped carrying 30 % copper (reported).

Ore-body.

The outcrop consists of 3 ft. width of gossany quartz and schist, striking east-north-east.

Thistle (M.C. ?).

Location, Etc.

This lies ½ mile north-west of the Buttercup.

Its area is not known, the ground being deserted and presumably abandoned, as not on the list of living claims and leases.

Development.

One shaft has been sunk to a depth of 24 ft., and a drive has been opened 4 ft. to the west at the bottom.

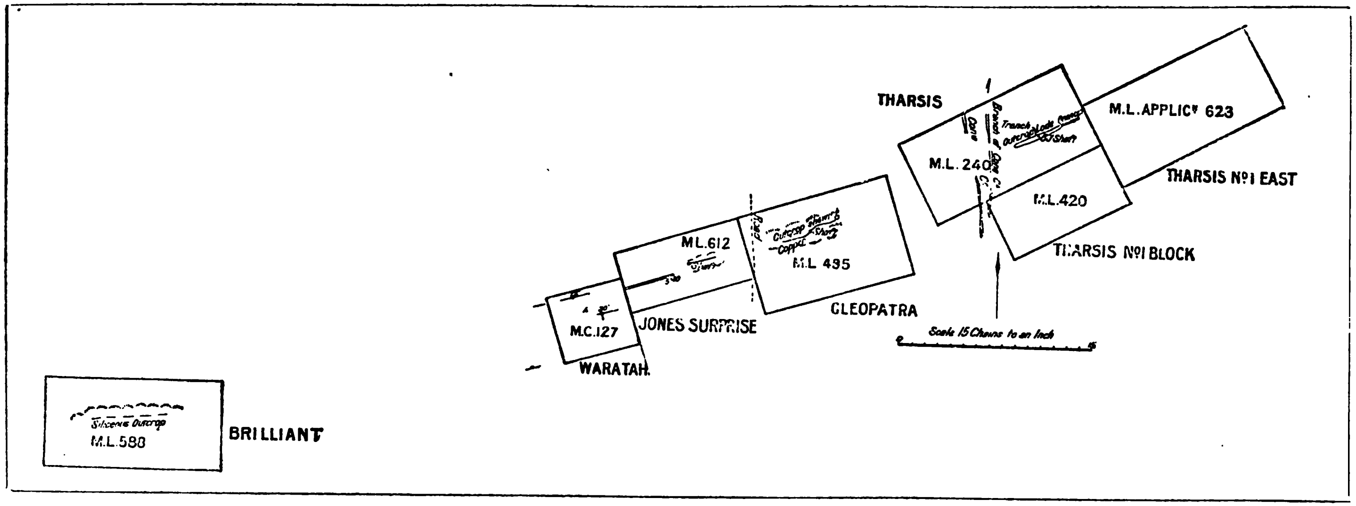
Ore-bodies.

An outcrop of granular quartzite, in chloritic schist, here strikes east 30° north, but, just to the west-south-west of the shaft, makes a bend and runs almost due west. Very little ore is visible in the crop but a little silicified limonite and chrysocolla was found near the shaft bottom, and in addition to a little malachite-stained gossan in the drive. The probability is, therefore, that very low-grade pyritic ore would be found on sinking.

About 20 ch. west of the shaft a patch of fine-grained cellular hæmatite has been located in the quartzite crop, the country here being slate.

THARSIS GROUP.

The Tharsis Group comprises the Brilliant, Waratah, Jones' Surprise, Tharsis, Tharsis East and Tharsis Block, all on the one crush-zone, which is marked by occasional siliceous outcrops of great size.



THARSIS
M.L. 240
Cone
Branch of Cone Ck
Trench
Outcrop Lode
Shaft
M.L. APPLICⁿ 623
THARSIS No. 1 EAST
M.L. 420
THARSIS No. 1 BLOCK
Scale 15 Chains to an Inch
0
15
M.L. 612
Shaft
M.L. 495
Road
Outcrop
Shaft
Copper
Shaft
CLEOPATRA
JONES SURPRISE
M.C. 127
WARATAH.
Siliceous Outcrop
M.L. 588
BRILLIANT

Brilliant (M.L. 588).

Mgr., Staubwasser.

LOCATION, ETC.

The Brilliant lies ½ mile west-south-west of the Waratah, and 1½ mile north-west of the blast furnace on Mount Start.

Its area is 10 ac. The ground was previously held as a claim, under the name of the Jumbo.

DEVELOPMENT.

The workings consist of one inaccessible shaft, 40 ft. deep, and one or two shallow holes 3 ch. from the eastern boundary and 1 ch. from the northern.

OUTPUT.

	2½ tons	shipped	by original prospectors (reported.)
1906 ...	5 ,,	,,	,, Hughes
Total ...	7½ ,,		
	5 ,,	at grass	carrying 10 % copper.

ORE-BODY.

The workings are situated in speckled siliceous schist, 3 ch. east of

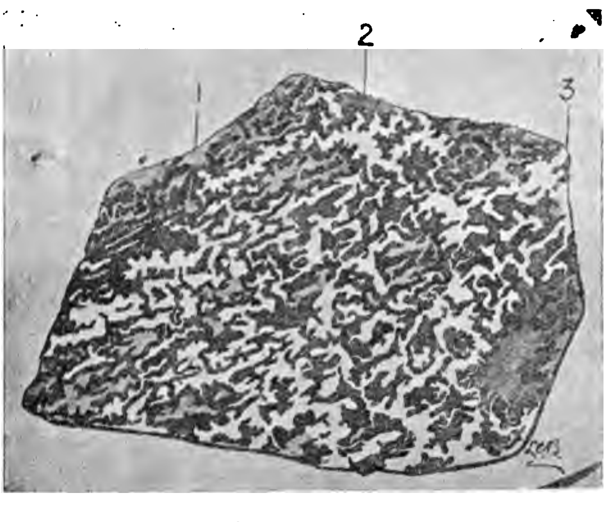


FIG. 12 (NATURAL SIZE).—RICH OXIDISED ORE, BRILLIANT.

1. Crypto crystalline malachite and chalcocite.
2. Earthy turgite.
3. Chrysocolla.

a great blow of quartz and quartzite, extending westwards for several chains and having some resemblance to a kneeling elephant. Only 2½ tons of ore have been shipped and 5 tons of seconds now lie at grass. The seconds, of which the copper content is not above 10 %, consist in great part of granular quartz, evidently replacing schist, and cemented by malachite and chrysocolla, with a little limonite, chalcocite and chalcopyrite.

The richest ore is a peculiar intergrowth of chrysocolla and malachite with earthy turgite, the last being in minute irregularly shaped particles, roughly aligned, in a base of the first and second. (Fig. 12). The copper minerals are seen to be in process of replacing chloritic schist, originally separating grains, lumps, and lenses of quartz. Some parts of the ore have suffered extensive silicification subsequently to partial oxidation of the chalcopyrite, that mineral now being often set in a dark siliceous matrix, also cementing white lumps and colourless crystals of quartz.

Waratah (M.L. 127).

Mgr., Wallace.

LOCATION, ETC.

The Waratah lies ½ mile north of the Blue Bell, and a little over 1 mile north-west of the blast furnace on Mount Start.

Its area is 400 ft. x 350 ft. Idle when inspected, most of the work having been done during 1905.

DEVELOPMENT.

Two shafts have been sunk, one near the centre of the claim to a depth of 30 ft. (inaccessible) and one 2½ ch. to the north-west, to a depth of 12 ft. Trenches have also been opened for 30 ft. east and west of the first shaft.

OUTPUT.

	15 tons	shipped	containing	30 %	copper	(reported)
	5 ,,	,,	,,	40 %	,,	,,
Total ...	20 ,,	,,				
	5 ,,	at grass	seconds.			

ORE-BODIES.

There are two well-defined parallel lines of outcrop on this lease, striking east-north-east and underlying 5 in 1 h. to the south-south-east. The eastern trench on the southern and larger crop exposes up to 5 ft. width of schist and quartz formation, underlying steeply southwards. It is reported that 15 tons of 30 % ore have been sent away, but the last 5 tons shipped yielded only 25 % copper. The seconds at grass amount to 10 tons, and consist of siliceous malachite, with perhaps 12 % copper.

The northern formation of quartz and crushed schist is 2 ft. 6 in wide and is on the line of strike of that worked in the Jones' Surprise. There was only a small seam of rich ore, but 5 tons of 40 % ore have been shipped from here; and 5 tons of seconds—siliceous tile-ore and malachite—are at grass.

A third line of formation, which should pass near the southern boundary of the claim, has been tried in a pothole 7 ch. west-south-west of the 30 ft. shaft.

Jones' Surprise (M.L. 612).

Mgr., Jones.

Location, Etc.

The Jones' Surprise is east-north-east of the Waratah, and west of the Cleopatra.

Its area is 5 ac. The lease had only just been taken up, in October last, having been formerly held as a claim by Hardist and Price.

Development.

The workings comprise: a shaft near the centre of the lease, originally 40 ft. deep but now caved in below 15 ft. from the surface; and a pothole 5 ft. deep, ½ ch. to the west-south-west.

Output.

Total ...	4 tons	shipped (reported)

Ore-bodies.

This lease takes in a prominent outcrop, 3½ ch. in length and 15 ft. in greatest width, similar in character to, though smaller and richer than, that on the Tharsis, on the line of strike of which it occurs. The country rock is schist and the outcropping formation, which dips steeply to the south, consists chiefly of dense quartz, with patches of chlorite and bands of schist impregnated with copper ores, chiefly along the centre of the crop where crushed. The rich ore, of which only 4 tons have been shipped from the shaft, occurs in bunches, the average tenor being low.

Cleopatra (M.L. 495).

Mgr., Johnson.

LOCATION, ETC.

The Cleopatra adjoins the Jones' Surprise on the east-north-east and is separated on the north-east by only 2 ch. from the Tharsis.

The country hereabouts is all flat, worn down.

Its area is 10 ac. The lease was under exemption, and deserted in October last.

DEVELOPMENT.

One shaft, 7 ft. x 4 ft., has been sunk vertically, near the centre of the lease, to a depth of 40 ft.

OUTPUT.

1906	...	$2\frac{1}{10}$ tons	shipped	by H. Johnson
		5 ,,	at grass,	carrying 20 %

ORE-BODIES.

A part of the Tharsis-Waratah crush-zone makes a large crop on this lease, 4½ ch. in length. Just at the shaft it strikes north-east, dipping very steeply to the south-east, but on the east it bends round and runs for 1½ ch. east-north-east towards the Tharsis and on the west runs for 3 ch. west-south-west towards the Jones' Surprise crop. The whole of the sinking was in a formation of jointed quartz lenses separated by crushed country. The quartz contains no copper ore, but flakes of chlorite are plentifully disseminated in parts of it. The interstitial schist is impregnated with limonite, malachite, tile-ore azurite, chrysocolla and very faint splashes of glance. About 5 tons of ore that should carry 20% copper have been picked out and paddocked.

Tharsis (M.L. 240).

Mgr., Matheson.

LOCATION, ETC.

The Tharsis lies 1¼ mile north of the blast furnace on Mount Start, and Cone Creek runs across it from north to south.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

The workings consist of an almost vertical shaft, 6 ft. x 3 ft., and 50 ft. deep, about 6 ch. south-south-west of the north-eastern corner; deep trench running 20 ft. north of the shaft; and an opencut, 120 ft.

long, 6 to 8 ft. wide and 7 ft. deep at the western end, 2 ch. east-north-east of the shaft. The opencut is being carried westwards from the eastern end of the crop.

OUTPUT.

1906	...	90 tons	at grass	carrying	12 %
		100 ,,	,,	,,	3 %

ORE-BODIES.

The Tharsis outcrop, which lies 2 ch. east of Cone Creek, is 6 ch. long and 42 ft. in greatest width, in the western part near the shaft, whence it tapers gradually towards the east. The crop rises, as a rounded ridge, 10 ft. above the surrounding flats. Its strike is east-north-east, and its dip is 6 to 7 in 1 h. to the south.

The crop consists of crushed schist, with crowded lenticular veins of quartz, the visible silica amounting to at least 50 % of the whole formation. The quartz has presumably segregated during the production of schistosity in the country rock, and that some of it has replaced country rock is indicated by the smooth partings noticeable throughout the formation, even where wholly of quartz. Some of the quartz is in the form of interlocking crystals and the interspaces are often occupied by a green chloritic mineral, the unreplaced residium of the original country rock. A few of the joints in the outcrop quartz are coated with malachite, but almost the whole of the copper-ore occurs as stains on the laminæ of the schist and as bunches in the same. Some of the bunches visible in the crop northeast of the shaft are 4 ft. in length and 2 ft. across and carry 10 % to 30 % copper, as malachite and tile-ore, but they are often separated by 5 ft. of very low-grade material.

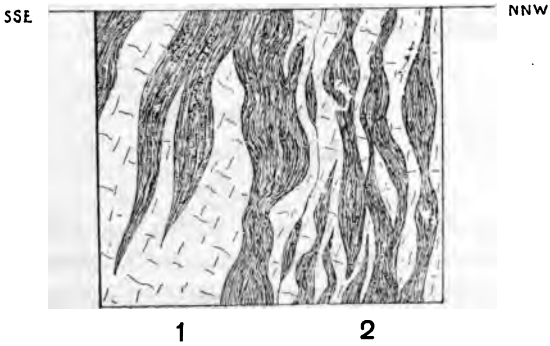


FIG. 13.—WESTERN END OF OPENCUT, THARSIS.

Scale : 4 ft. to an inch.

1. Quartz (cupriferous part dotted).
2. Schist (,, ,, ,,).

The face of the opencut exposes lenticular masses of quartz and schist dipping 7 in 1 h. to the south. (Fig. 13.) The quartz, which amounts to two-thirds of the whole, carries very little copper, but the interlaminated schists should average 5% copper as malachite. About 90 tons of ore, estimated to carry 12 % copper, have been stacked alongside the cut, the copper occurring chiefly as malachite staining the schist, but also to a small extent as tile-ore. The silica content is over 50 %, but iron should reach 10 %. The rejected material from the cut should carry 2 % copper.

The trench running north from the shaft exposes similar formation, dipping southwards 6 in 1 h. and averaging 7 % copper by the manager's assays.

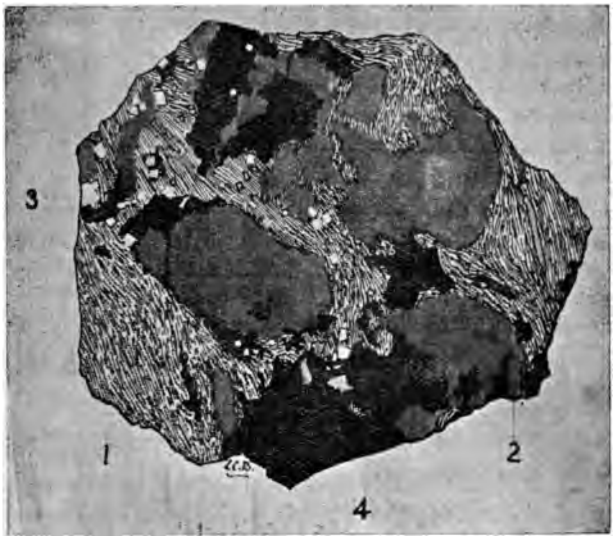


FIG. 14 (NATURAL SIZE).—TYPICAL ORE, 50 FT. LEVEL, THARSIS.

1. Schist
2. Quartz
3. Pyrite
4. Chalcocite.

The whole of the shaft is in schist-quartz formation with carbonates in the upper part but with bunches of chalcocite as well towards the bottom, where there is one 18 in. in diameter and carrying at least 30 % copper. There is also at the bottom a 9 in. band of red gossan, with a sprinkling of malachite, making its copper content 2 %, even if tile-ore is absent. Mr. Matheson has estimated from his assays that the whole of the material raised from the shaft should average

8 % copper. My surface sample from the whole of the dump consists of equal parts of quartz and schist. The quartz is crystalline and barren except for external films of malachite. The schist is chloritic, is stained throughout by malachite and in places by gossan, and contains a little chalcocite (glance) adjacent to quartz. (Fig. 14.) The following is the result of assay (Government Analyst):—

Copper	=	3·3 %
Gold	=	20 gr. per ton
Silver	=	2 dwt. ,,

The shaft has thus proved that, in one part at least, the formation is no less cupriferous at 50 ft. below than at the surface, and it does not appear to have been sunk in a specially favourable locality. Consequently a large supply of low-grade siliceous ore is to be relied on from this lease.

Tharsis No. 1 East (M.L. 623).

LOCATION, ETC.

This lease adjoins the Tharsis on the east.

Its area is 10 ac. It was deserted in October last, work having not yet commenced.

ORE-BODIES.

There are no crops on this ground.

Tharsis No. 1 Block.

Mgr., Corney.

LOCATION, ETC.

This adjoins the Tharsis on the south.

Its area is 5 ac. It was not manned in October last, and work had not then commenced on it.

ORE-BODIES.

No crop is visible on this lease, which has been taken up with the intention of sinking for the Tharsis ore-body if circumstances warrant it.

BELFAST GROUP.

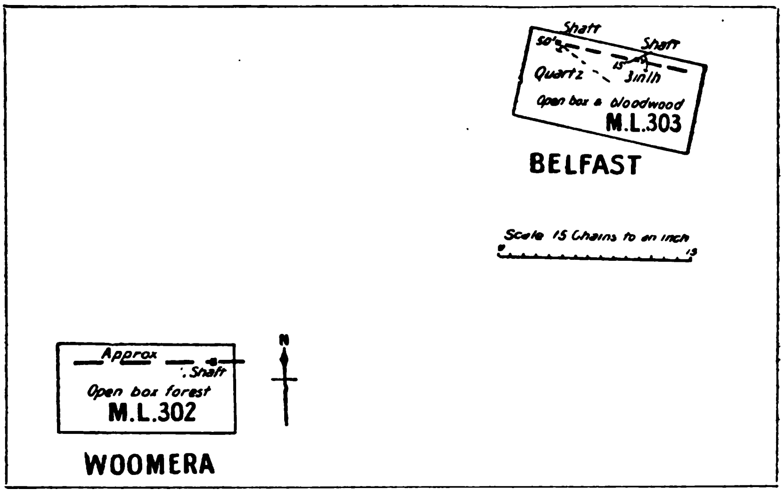
The Belfast group includes only the one lease, which is to some extent isolated from others on Cone Creek. The ore-body is due to regional metamorphism, but it has not been proved to lie on a crush-zone.

Belfast (M.L. 303).

Mgr., Matheson.

LOCATION, ETC.

The Belfast lies in flat country 2 miles north-north-east of the blast furnace on Mount Start, and 10 ch. south-east of the Cloncurry road. The mine is located in a flat-bottomed valley between a north and south row of worn-down hills, the backbone of a former range, about a mile to the east and the still less significant Rainbow ridge to the north-west.



Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate, which was opening it up at the time of my visit. Some confusion has arisen concerning the name of this lease, the manager referring to it in his reports as the Alabama.

DEVELOPMENT.

The main shaft is located 2½ ch. south-east of the north-western corner. It is accessible to a depth of 40 ft., where there is a staging and a drive 12 ft. to the north-west, but it is understood to have a total depth of 50 ft.* Another shaft, 15 ft. deep, lies 6 ch. to the east-by-south.

OUTPUT.

1906 ... 50 tons at grass carrying 15 % copper.

ORE-BODIES.

A few boulders of ironstained quartz and calcite constitute the crop at the main shaft. The strike appears to be east 38° south, towards a quartz crop near the centre of the lease, the dip being 2 in 1 h. to the south-west. The exposure in the main shaft is of a rather different character to most others on Duck Creek waters, consisting as it does of a cavernous formation made up of quartz, calcite and earthy gossan, in which chiefly the copper ores occur. The formation in the south-eastern end of the shaft is 3 ft. wide, but is not being broken down. In the drive on the opposite side of the shaft a total width of 8 ft. to 10 ft. of formation is being stoped out. Over one-half of it is quartz, and one-quarter cavernous calcite, the remainder being earthy-brown cupriferous limonite, which, besides being found between masses of quartz and limonite, forms a 12 in. band on the hanging-wall and a 6 in. to 18 in. body adjacent to the footwall quartz, the two bands being separated by 5 ft. of irregularly interpenetrating quartz and calcite. Chrysocolla occurs in the limonite, more especially in the calcareous nodules and some irregular bunches of chalcocite have been struck as well as tile-ore, but most of the copper is present as malachite. Most of the quartz contains cupriferous pyrite (perhaps leached chalcopyrite), generally surrounded by limonite. Secondary silica is very plentiful, both crystallised in cavities in the limonite and in amorphous form throughout the oxidised ore, cracks in which are filled with chrysocolla. Micaceous hæmatite is to be seen in bunches in the calcite, and also in thin sheets along the cleavage planes of the same mineral.

---

* Subsequently to my inspection some stoping was done above the 40-ft. level.

Some ore has been shipped, but the 50 tons paddocked at the shaft are not expected to run above 15%. My surface sample from this paddock contains: one quarter limonite and turgite with crystals of the original chalcopyrite (in process of alteration into limonite and glance), a little crystalline cuprite, fibrous malachite and coatings of earthy malachite on cracks, besides a little chrysocolla in the less siliceous turgite; one quarter very cellular but rather siliceous gossan, containing a little acicular malachite; one quarter ferruginous granular quartz, with bunches of siliceous gossan and coatings and fillings of chalcocite; fairly pure chalcocite (glance) veined by silica and coated with malachite; slightly ferruginous calcite with some chalcocite bearing limonite; a little dark schist stained by malachite; and occasional plates of hæmatite in the kaolin. Such ore, even though low in copper, would be valuable to the smelter for its iron and lime contents. The following is the result of assay (Government Analyst):—

Copper	=	14·8 %
Gold	=	1 dwt. per ton
Silver	=	1 ,, ,,

The eastern shaft is in a granular siliceous slate, on a separate body striking east 25° north, and dipping 3 in 1 h. to the south-south-east; and about 3 ch. from the quartz crop at the calculated intersection of the two lines. The ore-body in the shaft averages 12 in. in width, and consists of coarsely foliated specular iron (often beautifully rosetted and evidently replacing schist), gossan, limonite, calcite, malachite (some of it between the foliæ of the hæmatite), tile-ore, and dioptase (?). There are 5 tons of ore at grass, the copper in which does not exceed 5%. The ore may, nevertheless, be of value to the smelter, and the occurrence is of importance as indicating that the ore-bodies are due to regional metamorphism.

PIONEER CHIEF GROUP.

The Pioneer Chief Group is a scattered one, and includes four (possibly five) separate lines, on which are: the Blue Bell, Pioneer Chief and Marabah; the Noontide and Try Again; the Alabama; and the Easter Gift. None of these crops is of any extent.

Pioneer Chief (M.L. 231).

Mgr., Walsh.

LOCATION, ETC.

The Pioneer Chief is situated on the eastern bank of Cone Creek, ½ mile north of the blast furnace on Mount Start. The Cloncurry-Duck Creek road passes close to the workings.

The area is 20 ac. The lease is the property of the firm of Graham and Matheson, who purchased it from Price and Wallis, the prospectors, in May, 1906.

LITERATURE.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb tabulates the following analyses (Government Analyst):—

(s) Selected for shipment—

Copper ... .. = 28·0
Silica ... ... = 12·2
Iron protoxide ... = 21·0 Gold = 7 dwt. 19 gr. per ton.
Alumina ... ... = 1·6 Silver = 1 ,, 5 ,, ,,
Lime ... ... = 7·5
Sulphur ... ... = 5·7
76·0

(r) Rejected from ore raised—

Copper ... ... = 11·8
Silica ... ... = 21·0
Iron protoxide ... = 24·4
Alumina ... ... = 4·0
Lime ... ... = 9·3
Sulphur ... ... = 0·4
70·9

DEVELOPMENT.

The main shaft, vertical to 30 ft. and then underlying 80° for 55 ft., is about 4 ch. south-east from the north-western corner peg. The intention was to sink to 100 ft. and then to block out the ore, there being already a drive 25 ft. to the west at the 50 ft. level.* The water met in sinking has caused much inconvenience, necessitating the installation of a steam pump—10,000 gall. a day being rather too heavy to cope with by baling.

Another shaft, 32 ft. deep, lies ½ ch. east-south-east from the main one; and a pothole is 5 ch. to the north-north-east of the same.

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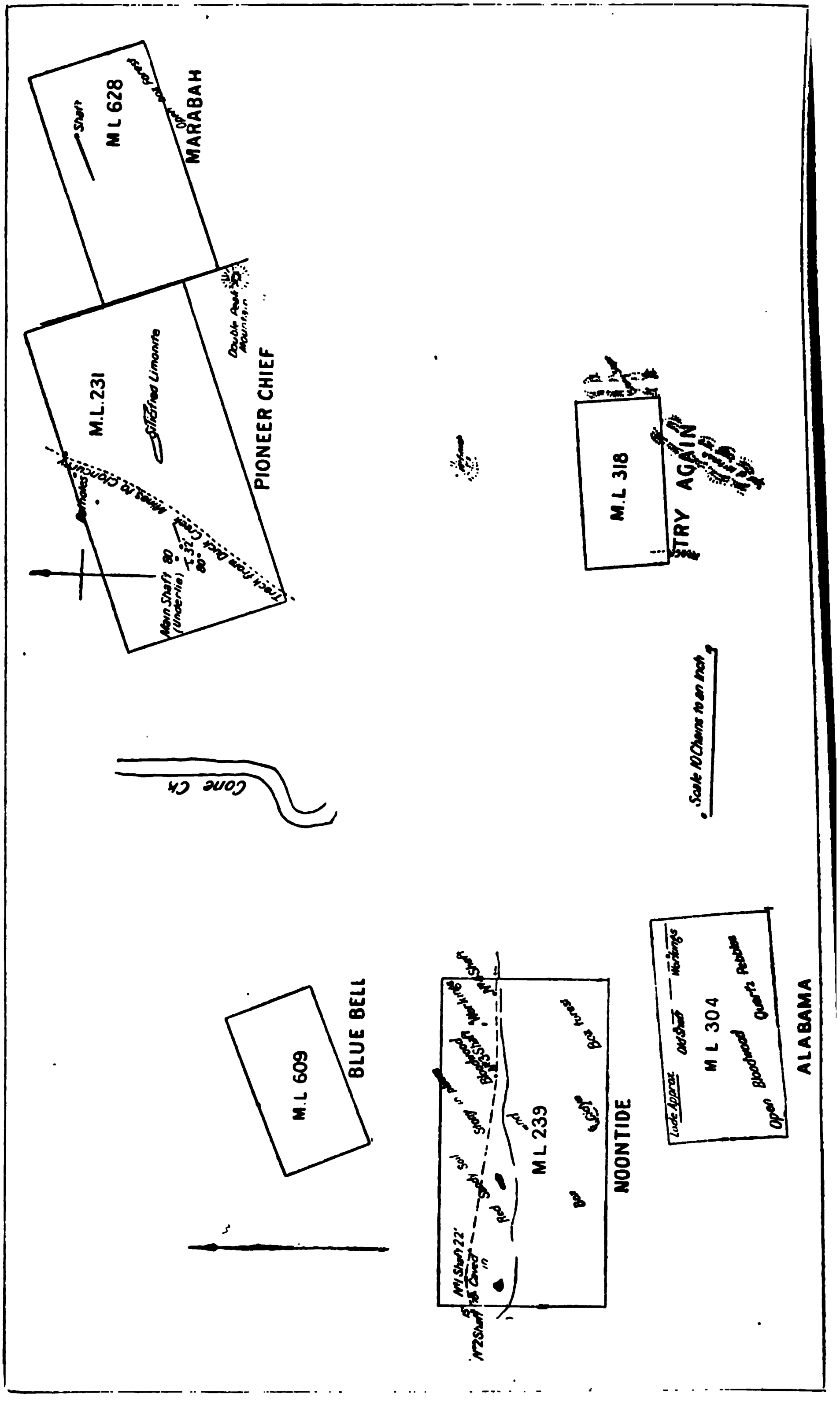
* The warden reported, in Jan., 1907, that the shaft was 115 ft. deep and that at the 104-ft. level drives were carried 20 ft. east and 23 ft. west.


M L 628
MARABAH
Shaft
M.L.231
PIONEER CHIEF
Silicified Limonite
Double Peak Mountain
Potholes
Main Shaft 80 (Underlie)
Track from Duck Creek
M.L 318
TRY AGAIN
Scale 10 Chains to an inch
Cone Ck
M.L 609
BLUE BELL
M L 239
NOONTIDE
No1 Shaft 22'
No2 Shaft
Soil
Red
Box
Box Trees
M L 304
ALABAMA
Lode Approx.
Old Shaft
Workings
Open Bloodwood
Quartz Pebbles

OUTPUT.

1904	$106\frac{10}{20}$	tons shipped	by Price and Wallis
1905	5	,,	,,
1906	29	,,	,,
	$140\frac{10}{20}$		
	?	,,	at grass (material not sorted).

ORE-BODIES.

The Pioneer Chief ore-bearing zone made little or no show near the main shaft, but 3 ch. to the east there is a barren crop 2 ch. long and up to 10 ft. wide—a crystallised quartz-bearing gossan indurated by a deposition of secondary chalcedonic silica, the quartz crystals now being set in a paste of silicified limonite. This should be tested by driving from the main shaft.

In the main shaft no defined ore-body was met within 20 ft. of the surface, that below dipping 80° to the south. Above the water-level, which is at 50 ft. beneath the surface, the ore was chiefly red clayey gossan and tile-ore, with bunches of chalcopyrite, enriched by chalcocite, but much native copper, in dense reddish gossan with infillings of crystalline calcite, appeared near the water. Mr. Walsh informed me that a small seam of secondary sulphides passed into the footwall at 50 ft., and several other streaks below water-level in the footwall are to be prospected for by cross-cutting. Chalcopyrite and pyrite stained by earthy chalcocite first came in, 3 to 4 ft. wide, at 56 ft. depth, under barren pyrite, seams of which were found on farther sinking overlying rich ore. Pyrite is especially in evidence towards the shaft bottom, where two seams of ore, separated by 2 ft. of country rock, can be seen; the northern one, 5 in. thick is of pyrite, and the southern 6 to 12 in. thick, is of cupriferous pyrite, richer at the eastern than at the western end.

The ore cuts out in the face of the western drive on the 50 ft. level but continues under foot.*

The country rock is a granular green slate, showing internal slickensides due to crushing near the hanging wall. In the formation the rock is black and chloritic.

In the northern pothole little copper was found.

The 32 ft. shaft is believed to be on a hanging-wall lode 20 ft. back from that being exploited in the main shaft. This is to be tapped by a crosscut from that shaft at the 100 ft. level. The Warden reported, in January, 1905, that the shaft was being sunk vertically to cut the ore-body at water-level.

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* Press reports state that 15 in. of ore was broken down in the western drive at the 104 ft. level, and that a body of ore was struck in the sump at 115 ft. level.

Marabah (M.L. 294).

LOCATION, ETC.

The Marabah adjoins the Pioneer Chief on the east.

Its area is 10 ac. Deserted and not inspected. The ground was first held as the Open Sesame, during 1905.

DEVELOPMENT.

One shaft has been opened to a depth of 22 ft. near the centre of the lease on the line of strike of the Pioneer Chief, here 2 to 3 ft. wide.

OUTPUT.

1904	...	23 tons	shipped by Price from the Open Sesame, etc.

Primrose (Extd. M.C. 267).

Mgr., Long.

LOCATION, ETC.

The Primrose is located on the west-north-western flanks of Mount Finish, between the Pioneer Chief and the blast furnace on Mount Start.

Its area is 1,600 ft. by 350 ft. The ground had been deserted for some time in October last.

DEVELOPMENT.

The main shaft, which is 30 ft. deep, lies 10 ch. south 6° east from the Pioneer Chief; another, 10 ft. deep, lies 1 ch. to the west, and the ground has been scratched for a chain beyond it. Besides these there are old trenches, 5 ch. south-east of the shaft.

OUTPUT.

1906	...	2 tons	at grass	
		4 ,,	,,	carrying 10 % copper.

ORE-BODIES.

In addition to the main ore-body there appear to be several small detached masses of ore on the lease. The country rock is a granular schist, with much sinter adjacent to the footwall of the ore-body.

The main shaft exposes a vein of quartz 15 in. thick, striking west 8° south and dipping 2 in 1 southwards, but cutting out in the western end. A little over 2 tons of ore is bagged at the shaft, but some of it may have come from other crops on the claim. The seconds, amounting to 4 tons, comprise quartz, quite 70%, cellular gossan and dense limonite with malachite and a little chalcopyrite; they contain perhaps 10% copper.

Nothing has been proved in the western shaft, which is too far to the north.

The trenches to the south-east expose veins of quartz 2 in. to 12 in. thick, in stained speckled schist, with bunches of poor carbonate ore but nothing of value.

Try Again (M.L. 318).

Mgr., Matheson.

Location, Etc.

The Try Again lies ¼ mile south of the Pioneer Chief, on the track from that mine to the blast furnace on Mount Start.

The area is 5 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate, who have, however, done no work on it.

Output.

1904	...	25 tons shipped.

Literature.

For title of report, numbered as below, see Introduction.

(8) Mr. Gibb's report contains the following analyses (Government Analyst):—

(s) Ore selected for shipment—

Copper	=	36·7 %
Silica	=	6·1
Iron protoxide ...	=	23·9
Alumina	=	1·4
Lime	=	tr.
		68·1

(p) Pyritic ore—

Copper	=	46·6	Gold = trace Silver = trace
Silica	=	2·0	
Iron protoxide ...	=	25·0	
Alumina	=	1·1	
Sulphur	=	10·1	
		84·8	

(r) Rejected ore—

Copper	=	20·9 %
Silica	=	29·4
Iron protoxide ...	=	23·4
Alumina	=	4·1
Lime	=	0·4
Sulphur	=	0·7
		78·9

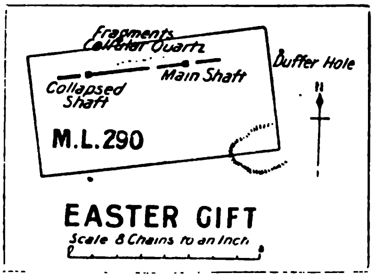
Easter Gift (M.L. 290).

Mgr., Webb.

Location, Etc.

The Eastern Gift lies 1 mile east of the blast furnace on Mount Start, and just to the west of the newly laid out township of Marabah.

The area is 5 ac. Deserted at time of visit, in October, but evidently lately worked.



DEVELOPMENT.

There is a collapsed shaft in the north-western corner of the lease, but the last work was done in a shaft 3 ch. west-south-west of the north-eastern peg. This shaft has been filled to within 15 ft. of the surface, with mullock from a stope at the western end. The only other opening is a trench, on the western boundary, now washed in.

OUTPUT.

1906 ...	6 tons	shipped	reported to carry 40 % copper
	2 ,,	at grass	carrying 40 % copper
	15 ,,	,,	,, 20 % ,,
	3 ,,	,,	,, 10 % ,,

ORE-BODIES.

The crop, which strikes east 5° north and dips 3 in 1 h. to the south, is marked between the shafts by fragments of cellular quartz. At the western shaft very siliceous cellular and granular hæmatite has been thrown out. A chain to the west quartz again crops, and on the western boundary of the lease limonite in quartz with crystalline malachite and tesselated chalcopyrite has been found by trenching. Some ore has been shipped from here, and 3 tons of seconds, rich in iron but also carrying 25% silica and running between 10% and 15% copper, remain at grass.

In the eastern shaft the lode is ill defined, especially on the hanging-wall, joints in which are much stained by azurite. It appears to cut out in the eastern end of the shaft, but, in the upper part of the stope at the western end, can be seen 18 in. azurite-bearing gossan, with secondary silica, the latter both crystalline and, towards the hanging-wall, in the form of brown chalcedonic chert. The ore at grass comprises chalcocite, tile-ore, chrysocolla, malachite and azurite. The firsts, of which there are 2 tons bagged at the mine, are believed to have averaged 40% and the 15 tons of seconds in the paddock should yield 20% copper.

The country rock is the nearest approach to a grey siliceous slate seen on the field. Developments scarcely allow of certainty as to the origin of the ore-bodies but the occurrence of hæmatite is suggestive of regional metamorphism.

Woomera (M.L. 302).

Mgr., Matheson.

LOCATION, ETC.

The Woomera lies 30 ch. north-north-east of the Pioneer Chief.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate, which is, however, doing nothing with it.

One shaft has been sunk in the north-eastern corner, but has caved in.

ORE-BODY.

The ore-body is understood to strike east and west.

Noontide (M.L. 239).

Mgr., Matheson.

LOCATION, ETC.

The Noontide lies 10 ch. west of Cone Creek ½ mile north of Duck Creek, and ½ mile north-west of the blast furnace on Mount Start. The country is very low and flat, being liable to flooding from Cone Creek.

The area of the lease is 20 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate, which, however, is doing no work here.

DEVELOPMENT.

A shaft, No. 1, has been sunk in the north-western corner of the lease to a depth of 22 ft., but, with the stopes, has now collapsed, leaving a cavity 20 ft. long, 10 ft. wide and 12 ft. deep.

Another hole, 15 ft. deep, lies 2 ch. to the west-by-south of this shaft, just outside the present boundary.

A third shaft, 12 ch. to the east-by-south of the first, is 30 ft. deep, and is now partly flooded.

A fourth shaft, originally 40 ft. deep but now fallen in, lies 5½ ch. to the east of the third. Besides these workings, there are several shallow potholes in this, the eastern, part of the lease.

OUTPUT.

		22	tons	shipped	by Sandelin Mac von and Milchurch, containing 15 % copper (Report)
1904	...	17	,,	,,	,, Boyd and Absolon, containing 30 % copper (Report)
1904	...	$23\frac{10}{20}$	,,		(Warden's return)
		$62\frac{10}{20}$			
1906	...	15	,,	at grass	carrying 15 % copper
		5	,,	,,	,, 10 % copper.

LITERATURE.

For title of report, numbered as below, see Introduction.

(8) **Mr. Gibbs gives the following analyses (Government Analyst):—**

(r) Rejected (three-fourths) from the ore raised—

Copper ... ... = 11·0 %
Silica ... ... = 41·8
Iron protoxide ... . = 19·6
Alumina ... ... = 2·2
Lime ... ... = 4·0
Sulphur ... ... = 0·6

79·2

(w) Whole reef—

Copper ... ... = 24·8
Silica ... ... = 25·8
Iron protoxide ... ... = 23·0
Alumina ... ... = 2·1
Lime ... ... = tr.
Sulphur ... ... = 0·3

76·0

ORE-BODIES.

The crop between the two western shafts strikes west 13° south, the ore-body dipping 70° to the south by east; between the eastern and western workings its strike is east 7° south; and between the two eastern shafts its strike is east and west.

The ore in the western shaft just outside the lease is siliceous, veined by malachite and impregnated by chalcocite. About 1 ton of 20% ore was got here.

At the western end of the hole on the site of No. 1 shaft, where the country is a granular chloritic schist, a formation of the crushed rock and lenticular quartz, 2 ft. in total width, is exposed, but at the eastern end there is only 12 in. of crushed schist with little or no quartz. The faces are very poor, and the shaft must have been sunk on a bunch of limited horizontal extent. It is reported that 22 tons of 15% ore were shipped from this shaft by the original prospectors, and 15 tons of ore are now paddocked near by. My sample from the heap consists of: dense earthy turgite with impregnations of chalcocite (glance) and veins and minute bunches of malachite, the last generally surrounded by an aureole of barren turgite; quartz and quartzose ore veined and stained with malachite, the quartz, even where crystalline, showing indications of schist incompletely replaced; and siderite splashed through with metallic glance (a most unusual occurrence) and altering into turgite. The silica contents is probably below 5%. The following is the result of assay (Government Analyst):—

Copper ... ... = 15·5 %
Gold ... ... = trace (less than 9 gr. per ton)
Silver ... ... = 4 dwt. per ton.

This comparatively low result proves that there is very little cuprite present in the earthy turgite.

No. 3 shaft appears to have been sunk on a barren quartz and cupriferous schist formation 3 ft. wide. The 5 tons of ore, stacked at the shaft, are reported to have come from near the surface. It is ferruginous, but also very siliceous, and probably does not carry more than 10% copper. The quartz fragments are set in a dark siliceous matrix impregnated with chalcocite and malachite. This secondary silica is younger than the chalcocite, which it surrounds, but older than the malachite, which occurs crystallised in minute cavities lined by quartz crystals.

No. 4 shaft is reported to have produced 17 tons of 30% ore.

Alabama (M.L. 304).

Mgr., Matheson.

LOCATION, ETC.

The Alabama lies 4 ch. south of the Noontide.

Its area is 5 ac. This is the property of the Willcocks Cloncurry Development Syndicate, which, however, is doing nothing here, the manager's reports published under the heading of Alabama referring to the Belfast.

Two shafts have been sunk near the northern boundary, one near the centre, the other in the north-eastern corner. They have both caved in.

ORE-BODY.

Quartz crops at the surface striking east 5° north.

Blue Bell (M.L. 609).

Mgr., Condon.

LOCATION, ETC.

The Blue Bell is located 5 ch. north of the Noontide.

Its area is 5 ac. The leaseholders were not present at the time of my visit, but had only just knocked off work.

DEVELOPMENT.

One shaft is being sunk, and at the time of my visit was 20 ft. deep. From it an opencut extends 20 ft. to the east.

ORE-BODY.

The strike of the ore-body, which apparently is in a crush-zone, is east 12° north, and the dip is 5 in 1 to the south. It has been traced by shoads for 3 ch. to the east of the shaft, and may possibly yet be proved to be a continuation of the Pioneer Chief.

In the cut near the shaft the body is 12 in. wide, and in the upper part of the shaft it is from 9 in. to 12 in. wide, but in the lower part another stained band is coming in, making the total thickness 2 ft. It comprises gossan, quartz and altered schist, in which occur nodules of mixed chalcocite and tile-ore, up to 9 in. in diameter, together with much sinter, but it is free from included quartz. The ore at grass comprised: 5½ tons bagged and estimated to carry 40 % copper, and 2 tons ready for bagging.

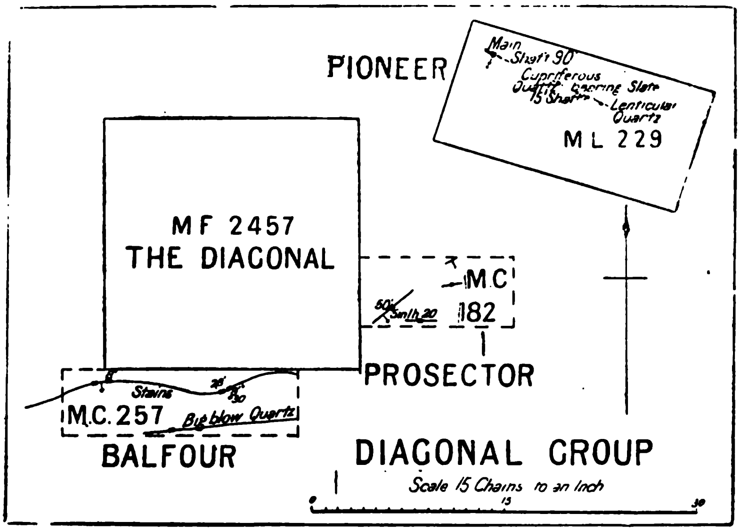
The country rock is a jointed chloritic schist, rendered very schistose along the narrow zone in which the ore occurs.

OUTPUT.

1906 ... 7½ tons at grass carrying 40 % copper.

DIAGONAL GROUP.

The Diagonal Group takes in leases and claims surrounding the freehold (2457) and all on distinct ore-bodies making insignificant crops—the Pioneer, Alone Hand, Prospector, and Balfour.



Pioneer (M.L. 229).

Mgr., Matheson.

LOCATION, ETC.

The Pioneer is situated on the southern side of Duck Creek, about one mile west of the blast furnace on Mount Start, which is 22½ miles south-south-west of Cloncurry.

The area is 20 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

The main shaft lies 3 ch. south-south-east of the north-western corner of the lease. The shaft is 8 ft. x 4 ft. in the clear. It was sunk 40 ft. (5 ft. below water level) by the first holders and the syndicate has deepened it to 90 ft.,* the underlie being 6 in 1 h. to the south below a depth of 30 ft.

An open-cut, 15 ft. deep, runs 6 ft. east and 40 ft. west of the shaft.

At 6, 8, 8½ and 9½ ch. east of the shaft potholes have been opened on the line, the second last being 15 ft. deep, and stoped for 10 ft. to the east.

The mine was idle when visited, but a pump had lately arrived on the ground and it was proposed to start work again shortly.†

LITERATURE.

For title of report numbered as below *see* Introduction.

(8) Mr. Gibb's report contains the following analyses (Govt. Analyst):—

(l) Left in reef—		(r) Rejected from ore raised—	
Copper	= 18·9	Copper	= 17·5
Silica	= 33·5	Silica	= 39·1
Iron protoxide ...	= 23·1	Iron protoxide ..	= 19·9
Alumina	= 2·1	Alumina	= 3·9
Lime	= 2.6	Lime	= 0·4
Sulphur	= 0·7	Sulphur	= 0·6
	80·9		81·4

OUTPUT.

1904 ...	26	tons shipped
1906 ...	10	,, ,,
Total	36	,, ,,
	30	,, at grass (Oct., 1906).

ORE-BODY.

The strike of the ore-body by the workings is west 25° north and the dip is southwards. The country rock is chloritic schist, the strike of which in the western end of the open-cut appears to be east-north-east. The hanging-wall country is much slickensided internally, wherefore the ore-body would seem to be on a crush zone.

The ore-body in the main shaft is reported to have averaged 8 to 10 in. in width, but at 30 ft. below the surface a schistose formation is stained and impregnated over a width of 18 in. with malachite and tile ore. The underlie of the shaft below 30 ft. was necessitated by a flat break, the lower part of the ore-body being 6 ft. to the south. Above the water-level (at 35 ft. depth) the ore is chiefly limonite, with tile-ore, malachite and some azurite, quartz being very plentiful, and the copper content 10 to 15%. Below the water-level the chalcopyrite is thinly coated in all crevices by earthy secondary sulphide and the ore raised from the shaft bottom is chalcopyrite with chalcocite, both dull and metallic, the copper content being 40%. There is about 30 tons of ore at grass, which the manager estimated would carry 24% copper. My sample of this consists of schist stained by malachite and iron oxides and carrying some chalcopyrite as well as impregnations of chalcocite, cellular gossan; and limonite with radiating malachite, and impregnations of chalcocite, as shown by its metallic streak, where not otherwise distinguishable. The Government Analyst returns:

---

* The Warden in Jan., '07, gave the depth as 114 ft.

† From Press reports it is learnt that the pump started work in November, 1906, and unwatered the shaft in one day, but the manager makes no mention of any further work done.

Copper	=	18·9 %
Gold	=	1 dwt. 4 gr. per ton
Silver	=	11 ,, ,,

A formation 3 to 4 ft. wide of slate and quartz with tile ore and malachite in the interstices is exposed in the first hole to the east of the shaft. The ore as a whole will not run much above 5% in copper.

In the 15-ft. hole there is 2 ft. 6 in. to 3 ft. of a confused formation, slightly iron-stained and containing occasional spheroidal bunches of glance, up to 6 in. in diameter. The hanging-wall shows slickensides, proving this to be still in the crush-zone. Towards the shaft bottom the quartz-bearing crushed schist formation is 2 ft. 6 in. wide and is slightly cupriferous for 6 in. from the hanging-wall

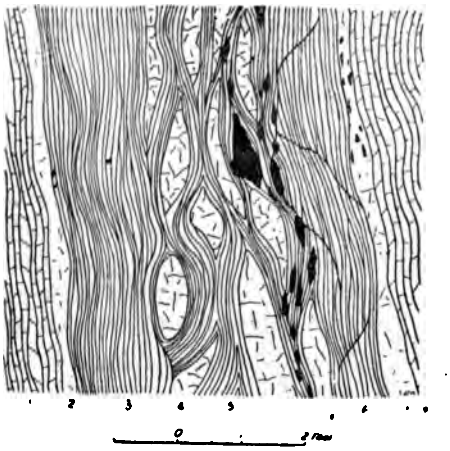


FIG. 15.—SECTION ORE-BODY, EASTERN END 15-FT. SHAFT, PIONEER.

1. Slate
2. Gossan and quartz
3. Schist
4. Quartz lens
5. Crushed schist (cupriferous, where shown black)
6. Internally slickensided schist
7. Ironstained quartz
8. Slate.

Two 3-in. bands of gossan and quartz in the foot- and hanging-walls respectively are separated from the main formation by 18 in. and 9 in. of schist. (Fig. 15.)

The easternmost hole apparently was opened on lenticular quartz veins, but some siliceous 10% ore has been raised here.

Alone Hand (M.L. 230).

Mgr., Wilmot.

LOCATION, ETC.

The Alone Hand lies a few chains south-east of the Pioneer.

Its area is 5 ac. It was not visited by me, as it was understood to be abandoned.

DEVELOPMENT.

One shaft has been sunk.

OUTPUT.

1904 ...	34	tons shipped, carrying 35 % copper	
1905 ...	$1\frac{12}{20}$	,, ,,	by Wilmot.
Total ...	$35\frac{12}{20}$	,, ,,	

Diagonal (M.F. 2457).

LOCATION, ETC.

The Diagonal lies 1 mile west-south-west of the blast furnace on Mount Start, on flat country adjacent to the flood plain of Duck Creek.

The area is 40 ac. The freehold has lately passed from the hands of Mr. A. Coats to the Queensland Copper Freeholds, Ltd. The property was deserted in October last, and, not yet having been re-marked, there was much doubt as to its exact location and extent.

DEVELOPMENT.

The main workings are in about the centre of the freehold. They comprise only potholes and trenches, all in a collapsed state. A number of other potholes were seen, there being several in the north-western corner.

LITERATURE.

For title of report numbered as below *see* Introduction.

(2) Mr. Jack did not inspect the Diagonal, but refers as follows to the selection adjoining it on the west:—

> In the selection numbered 2458 (2 miles W.N.W. of the Chinaman's) I saw two lodes. The first runs west 10 degrees south, is well defined, and about three feet wide, with a dip to south 10 degrees east at 75 degrees. Besides green carbonate of copper and some hæmatite iron ore, a good deal of very fair grey ore is visible. This is a sound payable lode. A second lode parallel to that last described is said to occur in the same selection, but we were too pressed for time to visit it.
>
> A hundred yards to the south, still in the same selection, is a third lode with two quartz reefs running to the S.W. A considerable quantity of green carbonate of copper is visible on the surface of the lode. The country is chlorite slate and grey-wacke, turned up on end and having a strike to W.S.W.

(7) Mr. Rutherford reports:

> Three quartz outcrops were examined on this area, all running more or less parallel in an east-north-east—west-south-west direction. The middle outcrop can be traced for 50 yds. The quartz is hard and unpromising looking, and lies in schist. From an irregular excavation 18 yds. long on the line of outcrop and 6 ft. deep, 17 tons of rich ore are said to have been removed. An examination of this hole shows that it has contained a lenticular pocket of ore lying in the bedding of the schist and completely cutting out on all sides. Continuing to the west a similar excavation 30 ft. long and 4 ft. deep shows where a second bunch of ore has been removed. The farthest south of the outcrops shows well defined on the surface, but a trench 6 yds. across shows the quartz to be lying on the surface in shallow foldings of the schist. . . . The farthest north of the outcrops shows for a distance of 43 yds. stained in places with green carbonate. . . It is possible that these two outcrops, if further prospected, may be found to contain small pockets of ore similar to those found in the middle outcrop.

ORE-BODIES.

Two main ore-bearing zones have been tried on this freehold, but a number of others are to be seen on which little or no work has been done. The country being flat and covered with quartz rubble, still others may yet be discovered.

The northernmost consists of lenticular quartz-bearing schist, with interstitial malachite, tile-ore and glance, the copper ore in some parts forming bodies 2 ft. thick and at the best averaging 15% copper. It has been traced for a distance of ½ mile, but has been opened only by potholes at irregular intervals, though worthy of a little more attention. The country rock is chloritic schist, of which the strike is east 38° north and the dip 85° to the south-east.

The southern zone can be followed for nearly 20 ch. from the Prospector boundary to the west-south-west, there being quartz crops up to 5 ch. in length and 18 in. to 10 ft. across, between which trenches have proved from 6 in. to 2 ft. of cupriferous gossan, of a promising appearance, more especially towards the west.

Prospector (M.C. 182).

Mgr., Sandelin.

LOCATION, ETC.

The Prospector lies ¼ mile south-south-west of the Pioneer, and adjoins the Diagonal on the east.

The area is 800 ft. x 350 ft. In October last it was being worked on tribute.

DEVELOPMENT.

The main shaft, 50 ft. deep, is in the south-western corner of the claim; a drive runs south-west for 15 ft. at the bottom, just above water-level. This drive is to be continued 50 ft. and at the same time overhead-stoping will be carried on. Another shaft, 20 ft. deep and inaccessible, is 2½ ch. to the east-south-east. Trenches run 10 ft. east and west of this shaft, and an old trench lies 1 ch. to the west. A pothole has been opened 5 ch. east-north-east of the main shaft. Old trenches lie on the boundary 2 ch. north of the pothole; one is 10 ft. deep and they extend over a total length of 50 ft.

Output.

1906 ... 10 tons in transit, Oct., 38 to 42 % assays.
20 ,, at grass, 30 % copper

Ore-Bodies.

There are four separate outcrops within this claim, none of them striking in quite the same direction, and perhaps representing four separate crush-zones.

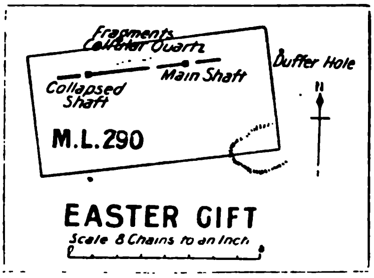
That at the main shaft strikes east 40° north dipping 5 in 1 h. to the south-east. Ore can be traced for 25 ft. to the south-west of the main shaft, and gossan and quartz show at the surface for 30 ft. further. In the shaft the ore in the north-eastern end is only 3 in. wide from top to bottom, but varies in thickness between 9 in. and 15 in. in the south-western end, being 20 in. wide at 40 ft. beneath the surface. The body pinches to 2 in. in width in the face of the drive, but is 18 in. wide nearer the shaft and further work may reveal another bunch. The ore consists of dull amorphous chalcocite and the crystalline form known as glance, of malachite, chiefly encrushing, of tile-ore in limonite, gossany in part, and of chalcopyrite, which appeared first in small quantities at 35 ft. below the surface. The amount of quartz is increasing in the lower part of the shaft. The drive exposes gossan with quartz and malachite carrying bunches of chalcocite. A few limy floors or horizontal joints, generally considered specially favourable for the occurrence of rich ore, were noticed in sinking the shaft.

The country rock at the main shaft is schist, that of the footwall being more jointed and less crushed than that of the hanging-wall, but there is a persistent 3 in. band of kaolinised flucan on the former, while flucan is seen only in some places on the hanging-wall, just within which, however, is a polished face. The flucan seems to have influenced the precipitation of the copper ores, more especially the malachite, though, in the face of the drive, the irregular nodules of chalcocite are more abundant adjacent to the footwall flucan than in the gossany formation towards the hanging-wall. The above evidence points to these ore-bodies being on a remarkably well-defined crush zone. There are 8 tons of 30% ore at grass and 3 or 4 tons of 20% seconds.

The pothole 5 ch. east-north-east of the main shaft exposes 18 in. of quartz and limonite running east 10° north. Some copper ore has been taken from here and the indications warrant further sinking. This body may possibly be in the continuation of the zone worked in the main shaft, though off the direct line of strike. The country rock is schist, dipping steeply to the south.

The trenches on the northern boundary are on ore-bodies, striking west-south-west and underlying south-south-east. The ore consists of malachite and tile-ore, and the last lot shipped ran 30%

The area is 5 ac. Deserted at time of visit, in October, but evidently lately worked.



Development.

There is a collapsed shaft in the north-western corner of the lease, but the last work was done in a shaft 3 ch. west-south-west of the north-eastern peg. This shaft has been filled to within 15 ft. of the surface, with mullock from a stope at the western end. The only other opening is a trench, on the western boundary, now washed in.

Output.

1906 ...	6 tons	shipped	reported to carry	40 % copper
	2 ,,	at grass	carrying	40 % copper
	15 ,,	,,	,,	20 % ,,
	3 ,,	,,	,,	10 % ,,

Ore-bodies.

The crop, which strikes east 5° north and dips 3 in 1 h. to the south, is marked between the shafts by fragments of cellular quartz. At the western shaft very siliceous cellular and granular hæmatite has been thrown out. A chain to the west quartz again crops, and on the western boundary of the lease limonite in quartz with crystalline malachite and tesselated chalcopyrite has been found by trenching. Some ore has been shipped from here, and 3 tons of seconds, rich in iron but also carrying 25% silica and running between 10% and 15% copper, remain at grass.

In the eastern shaft the lode is ill defined, especially on the hanging-wall, joints in which are much stained by azurite. It appears to cut out in the eastern end of the shaft, but, in the upper part of the stope at the western end, can be seen 18 in. azurite-bearing gossan, with secondary silica, the latter both crystalline and, towards the hanging-wall, in the form of brown chalcedonic chert. The ore at grass comprises chalcocite, tile-ore, chrysocolla, malachite and azurite. The firsts, of which there are 2 tons bagged at the mine, are believed to have averaged 40% and the 15 tons of seconds in the paddock should yield 20% copper.

The country rock is the nearest approach to a grey siliceous slate seen on the field. Developments scarcely allow of certainty as to the origin of the ore-bodies but the occurrence of hæmatite is suggestive of regional metamorphism.

Woomera (M.L. 302).

Mgr., Matheson.

LOCATION, ETC.

The Woomera lies 30 ch. north-north-east of the Pioneer Chief.

Its area is 10 ac. It is the property of the Willcocks Cloncurry Development Syndicate, which is, however, doing nothing with it.

One shaft has been sunk in the north-eastern corner, but has caved in.

ORE-BODY.

The ore-body is understood to strike east and west.

Noontide (M.L. 239).

Mgr., Matheson.

LOCATION, ETC.

The Noontide lies 10 ch. west of Cone Creek ½ mile north of Duck Creek, and ½ mile north-west of the blast furnace on Mount Start. The country is very low and flat, being liable to flooding from Cone Creek.

The area of the lease is 20 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate, which, however, is doing no work here.

DEVELOPMENT.

A shaft, No. 1, has been sunk in the north-western corner of the lease to a depth of 22 ft., but, with the stopes, has now collapsed, leaving a cavity 20 ft. long, 10 ft. wide and 12 ft. deep.

Another hole, 15 ft. deep, lies 2 ch. to the west-by-south of this shaft, just outside the present boundary.

A third shaft, 12 ch. to the east-by-south of the first, is 30 ft. deep, and is now partly flooded.

A fourth shaft, originally 40 ft. deep but now fallen in, lies 5½ ch. to the east of the third. Besides these workings, there are several shallow potholes in this, the eastern, part of the lease.

OUTPUT.

		22	tons	shipped	by Sandelin Mac von and Milchurch, containing 15 % copper (Report)
1904	...	17	,,	,,	,, Boyd and Absolon, containing 30 % copper (Report)
1904	...	$23\frac{10}{20}$	,,		(Warden's return)
		$62\frac{10}{20}$			
1906	...	15	,,	at grass	carrying 15 % copper
		5	,,	,,	,, 10 % copper.

Mountain Maid (M.L. 526).

Mgr., Johnson.

LOCATION, ETC.

The Mountain Maid lies south of the Balfour and 1¼ mile south-west of the blast furnace on Mount Start.

The area is 10 ac. The lease was idle in October last, having lately been placed under option, with the Columbia and Caine's King.

DEVELOPMENT.

The workings comprise four open-cuts. No. 1 cut, 20 ft. long, is near the centre of the lease; No. 2 cut, 20 ft. in length, is 3 ch. to the west; No. 3 cut, only 3 ft. in length, is 10 ft. further west; and No. 4 cut, 6 ft. long, is 1 ch. beyond.

ORE-BODIES.

The Mountain Maid crop, which is about 12 ch. south of the Balfour, is a very prominent one, beginning at 5 ch. from the eastern boundary of this lease and continuing without a break for 2½ ch. into the No. 1 West. The eastern part is 24 ft. across, and rises 6 ft. to 15 ft. above the general level of the ground. The strike is east-north-east and the dip 5 in 1 h. to the south-south-east. Several small patches of chalcocite and malachite have been located near the eastern extremity of the blow, but the outcrop as a whole is not a very kindly one, iron being present in only small amounts.

No. 1 cut exposes, beginning at the east: 5 ft. of decomposed ironstained rock; 3 ft. malachite-stained material; 4 ft. somewhat gossany granular quartz; 3 ft. slightly copper-stained granular quartz; 3 ft. ferruginous quartz and schist and 18 in. green-stained quartz. My sample, taken from over a width of 18 ft in the cut, consists of: black schist, slightly stained by malachite; granular quartz, replacing schist and lined on cracks with malachite; crystalline quartz, coated with malachite; cellular limonite; and earthy gothite, carrying crystalline malachite. The following is the result of assay (Government Analyst):

Copper ... ... = 4·3 %
Gold ... ... = trace (less than 9 gr. per ton)
Silver ... ... = „ („ „ „)

No. 2 cut exposes schists, partly replaced by granular quartz slightly stained by malachite, and expected to average 10% copper over a width of 20 ft., but not likely to improve much beneath the surface.

No. 3 cut, which has only just been commenced on the southern side of the crop, exposes only copper-stained rock.

No. 4 cut, also on the eastern side of the crop, exposes schists with lenticular quartz veins and a 12 in. body of gossan worth sinking on, as likely to improve. The whole 6 ft. visible may average 1% copper.

Mountain Maid No. 1 West (M.L.)

Mgr., Conors.

LOCATION, ETC.

The No. 1 West adjoins the Mountain Maid on the west.

The area is 5 ac. The ground was not manned, being exempt, when inspected in October last.

The only work done is an open-cut, 2½ ch. west of the Mountain Maid boundary. It is 30 ft. in length and 7 ft. deep.

ORE-BODY.

The Mountain Maid crop in this lease rises 15 ft. above the flats. The cut exposes schist, in great part replaced by quartz, leaving only scattered flakes of chlorite. The whole is very poor, the inner 12 ft. of the cut being almost entirely quartzite, but, for 8 ft. to the east of that, schist and quartzite are ironstained in parts and carry a little malachite, averaging perhaps 1% copper.

Columbiad (M.L. 500).

Mgr., Baker.

LOCATION, ETC.

The Columbiad lies a few chains east-north-east of the Mountain Maid.

The area is 10 ac. No one was on the lease when visited in October last, the lease being under exemption.

DEVELOPMENT.

The only excavation of any extent is a trench, 10 ft. long and 2 to 5 ft. deep, on a low hill in the eastern part of the lease. It is intended to sink a shaft 14 ch. to the west.

ORE-BODIES.

The Mountain Maid crop continues into this lease for several chains, when there is a blank and then a crop for 7 ch. again. The crops rise 10 ft. above the ground and crown low hillocks, or ridges, 10 ch. apart, the eastern one having an elevation of 50 ft. above the flats. In the western part of the main crop only one or two small patches of copper ore have been noticed and removed; but on the slope of the hillock, 2½ ch. to the south of the summit, a patch of a few tons of malachite, tile-ore and chalcocite has been found in a ferruginous quartz crop. This should be sunk on, though probably only an isolated bunch.

The trench on the eastern hill is in a quartzite crop 7 ch. long up to 1 ch. wide and rising 10 ft. out of the ground and showing a little gossan in the northern part. The exposure consists of schist, partly ironstained, and quartz, about 18 in. of the latter in the centre of the cut carrying at least 25% glance, and the whole being stained by malachite, so that the full 10 ft. width should average 5% copper. There are at grass 5 tons of ore containing at least 15% copper, and the refuse amounts to an equal quantity. A shaft should be sunk here and cross cuts opened.

Caine's King (M.L. 577).

Mgr., Baker.

LOCATION, ETC.

Caine's King lies about ½ mile east-by-north from the Columbiad, half-way between that lease and Duck Creek.

Its area is 10 ac. It was exempt and deserted when visited in October last.

DEVELOPMENT.

The workings comprise a vertical shaft, 30 ft. deep, at the western end of the crop; a trench (*a*), 6 ft. long, 1 ch. to the east; a trench (*b*), 10 ft. long, 1½ ch. further east; and a trench (*c*), 10 ft. long, 1½ ch. still further east.

OUTPUT.

1906 ... 2 tons shipped, containing 23 to 24 % copper (*fide* Mr. Johnson).

ORE-BODIES.

The chief crop, which strikes east 10° north, is 6 ch. in total length, and has a width of from 10 to 15 ft., there being a second crop, 2 ch. long, ¼ ch. to the east. It consists of schistose quartz, much of it as interlocking crystals, as at the Tharsis. That it replaces a crushed schist is indicated by thin lines of chlorite. It is slightly iron-stained and occasional patches of gossan and malachite are to be seen, but there is very little rich ore, and no large body even of medium grade.

The eastern crop, which rises 5 ft. above the adjacent flats, is quartz with traces of copper.

At the northern end of the main crop malachite is showing in the quartz; and the trench (*c*) exposes both malachite and azurite with a little chrysocolla in quartzite, the average grade of which however is low.

Much gossan shows at the surface to the south of this trench, occurring with quartz, in one place over a width of 10 ft. This crop is worth sinking and testing for copper at a depth, from which the whole body could be developed.

The trench (*b*) has been opened on a small patch of malachite-bearing ore of no extent.

Trench (*a*) proved only ferruginous and cupriferous schist.

The shaft is being sunk to meet the lode on the underlie, being 10 ft. below and 15 ft. south of the cap which rises 20 ft. above the neighbouring flats.

Occasional bunches of ore were met and between 2 and 3 tons of 23% ore have been shipped. The 6 tons seconds at grass are made up of schist and quartz with malachite and azurite, and they should average 15% copper.

Atlanta (M.L. 576).

Mgr., Baker.

LOCATION, ETC.

The Atlanta lies ¼ mile east of the Caine's King and about ½ mile south-west-by-west of the blast furnace on Mount Start. The workings are alongside the Duck Creek-Boulia road.

Its area is 12 ac. The ground was until lately held as the Keystone (M.C. 253).

DEVELOPMENT.

The workings comprise an inaccessible shaft, 20 ft. deep, with a crosscut 4 ft. south ½ ch. west of the road, and a pothole, 4 ft. deep, 3 ch. to the west of the shaft. This work was done by the former claim-holders.

OUTPUT.

1904	...	2	tons shipped by Baker
1906	...	$3\frac{2}{20}$	tons ,, ,, Absolon (source doubtful)
		$5\frac{2}{20}$	,,

ORE-BODIES.

A quartzose outcrop extends from the road for 4 ch. to the west, and in it are small irregular bodies of tile-ore and malachite, one of which, struck in the shaft, yielded 3½ tons of 40% ore. The ore consisted of glance in quartz stained by malachite, and was accompanied by much sintery lime-magnesia carbonate.

CHINAMAN GROUP.

The Chinaman crush-zone has been traced a distance of 2½ miles and besides the freehold three leases and two claims have been pegged out.

Chinaman (M.F. 2453).

LOCATION, ETC.

The Chinaman freehold lies 1 mile south by east of the blast furnace on Mount Start and extends eastwards from the banks of Duck Creek for 34 ch.

The area of the freehold is 58 ac. At the time of my visit it was deserted, being the property of Messrs. Coats and Robertson. It has now been taken over by the Queensland Copper Freeholds, Ltd.

DEVELOPMENT.

The extreme western workings, which are within 3 ch. of Duck Creek and have collapsed, comprised only shallow shafts. A pothole has been opened at 1½ ch. to the east of them. The company's cut which is 30 ft. long and 5 ft. deep, and near the north-eastern corner, was opened 25 years ago. Another small trench opened lately lies 4 ch. to the west.

LITERATURE.

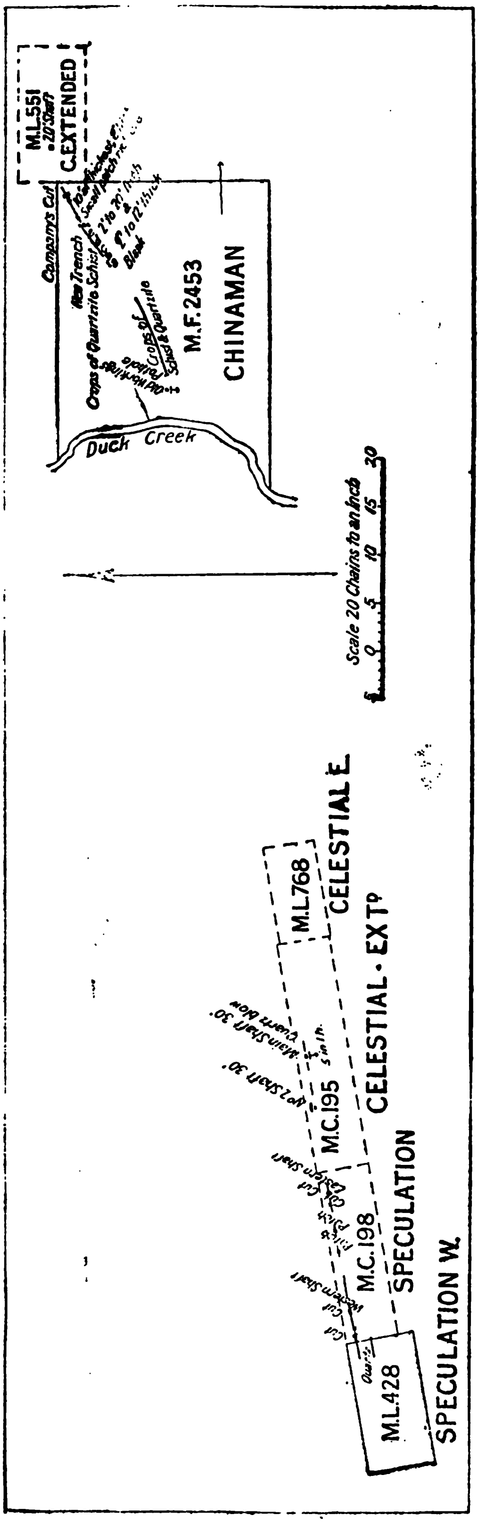
For titles of reports numbered as below *see* Introduction.

(2) Mr. Jack's reference to the Chinaman is as follows:

> *The Chinaman's Lode* occurs on the left bank of Duck Creek, about a mile and a-half S.E. of No. 2459. It runs from west 30 degrees south to east 30 degrees north. It is a quartz reef, standing from 3 feet to 15 feet above the general level, and measuring 17 feet across. It runs for nearly a quarter of a-mile through slate, whose strike is parallel to the lode. The quartz has its cavities coated with green carbonate of copper, and very often the quartz when broken up is found to be intimately mixed with carbonate of copper. Both slate and ore are highly chloritic.

(4) Mr. Cameron added to the above:

> Of these lodes, the only one visited was the Chinaman's Lode, as it was the only one on which any prospecting work has been done since Mr. Jack's visit. A trench has been driven across the outcrop near the northern end, and shows about six feet of chloritic ore and quartz, interbedded with slates. A bulk assay of this 6 feet gave 16·36 per cent. of copper, a trace of gold, and 4 dwt. 13 gr. of silver.


M.L.551
•20' Shaft
C.EXTENDED
Company's Cut
New Trench
Crops of Quartzite Schist
Old Workings
Potholes
Crops of Schist & Quartzite
M.F.2453
CHINAMAN
Duck Creek
Scale 20 Chains to an Inch
0 5 10 15 20
CELESTIAL E.
M.L.768
CELESTIAL · EXTᴰ
Main Shaft 30'
Quartz blow
No 2 Shaft 30'
M.C.195
Eastern Shaft
Cut
Rich
M.C.198
SPECULATION
Western Shaft
Cut
Quartz
M.L.428
SPECULATION W.

(7) Mr. Rutherford wrote:

> This includes an outcrop of friable quartz, associated with schist rising 15 ft. in places above the level of the surrounding country, and traceable for a distance of 350 yds. along the bedding of the schists in an irregular north-east and south-west direction. The only work done consists of a trench across the north end of the outcrop. This cutting shows 5 ft. of schist associated with quartz and impregnated with copper carbonate. This band of schist underlies the quartz outcrop from which undoubtedly the copper has been leached. . . .
>
> Following the outcrop to the south it is seen to follow the foldings of the schist with which it is intimately mixed. In places it measures 17 ft. across, while in others it thins down to 3 or 4 ft. It shows carbonate stains in patches all the way along. I consider this to be not a true outcrop, but a deposition along the bedding of the schist of silica carrying copper in solution. This latter has been leached out to a considerable extent and deposited in the underlying schist. There is little doubt that a considerable quantity of impregnated schist such as is lying at grass, could be got from the western side of the outcrop to a depth of 10 to 12 ft., but otherwise I consider the property of little value.

ORE-BODIES.

The Chinaman outcrops extend from the south-western to the north-eastern part of the lease, the general strike being east-north-east and the dip a high angle to the south-south-east. The crops mark areas of silicification and segregation of silica along a crush-zone and their value appears to me to have been much over-estimated presumably owing to the prevalence of green stains of malachite. The zone has not been proved to continue eastwards of the freehold but the Celestial and Speculation (claim) are on its westward extension.

At the western workings a formation of quartz rubble and schist reaches the surface. It is 2 ft. to 2 ft. 6 in. wide and dips 5 in 1 h. to the south.

Beyond the pothole to the east of the old workings, in which gossan is exposed, the crop runs for 10 ch. east 18° north, showing in places as quartzite, in others as schistose quartz and in still others as schist, with thin partings of quartz.

After a blank of 4 ch. quartzite rises like a wall to 20 ft. above the flat and continues north 51° east without a break for 5¼ ch. to the new trench. The quartzite is to some extent lenticular and is divided by longitudinal joints dipping 5 in 1 h. to the south-east. It contains a few rich patches but there is very little copper in the whole mass. The first bulge (*a*) on the plan, is 1 ch. long, 10 ft. high and 10 ft. in greatest thickness; it exhibits only occasional stains of malachite and limonite. The neck (*b*) is ½ ch. long, 2 ft. 6 in. thick and rises only 2 ft. above the ground. The bulge (*c*) is 1¼ ch. long, 10 ft. thick and 10 ft. high; in the southern part there is much schist containing iron and copper ore. The richest part of the crop is that within 6 ft. of the footwall, but this contains at least

50% quartz and not more than 3% copper, though many faces are painted a bright green, owing to a small quantity of malachite having leached out. The copper occurs almost entirely in the schist surrounding lenses of quartz. On the second contraction (*d*), which is ½ ch. long, there is much limonite and some malachite. The last bulge (*e*) is 2 ch. in length; in the central part it is 12 ft. wide; and, in the southern part, where 6 ft. wide, it is comparatively rich in malachite.

The new trench is between the northern extremity of this bulge and another overlapping lens to the east. The copper here also occurs between the laminæ of the schists and in cracks of the quartzite. A small quantity of presumably payable ore has lately been removed.

The crop between the trench and the company's cut, 4 ch. to the east 27° north, rises to a height of 8 ft. and is 10 ft. through at the widest part. It comprises schistose quartzite, with stains and patches of malachite. Two bunches of rich ore have been removed from the southern side of the blow at 1 ch. and 2½ ch. east of the new trench.

The company's cut exposes a footwall of kaolinised slate, dipping 2 in 1 h. to the south. On the footwall is 6 in. barren quartz; next to that is 6 ft. strongly copper-stained schist, with lenses of quartz decreasing downwards in width; then 5 ft. of iron-stained quartzite, increasing downwards; then 18 in. of quartz-bearing gossan also widening downwards; and lastly 6 ft. width of barren quartz and schist. (Fig. 16.) There is stacked at this cut some 40 tons of firsts, chiefly malachite stained schist and quartzite, with lumps of rich ore few and far between It will probably run 10% copper. The seconds, amounting to 3 tons, will not carry more than 3% copper.

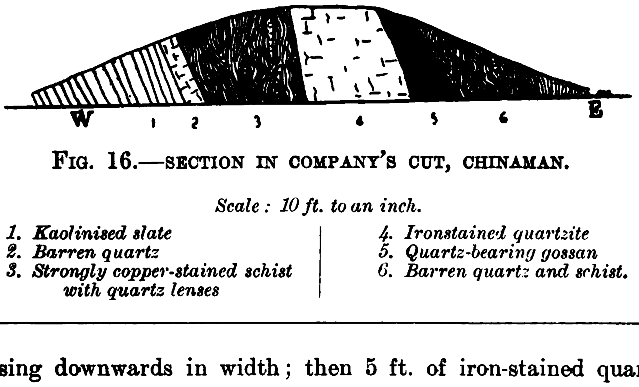


FIG. 16.—SECTION IN COMPANY'S CUT, CHINAMAN.

Scale: 10 ft. to an inch.

1. Kaolinised slate
2. Barren quartz
3. Strongly copper-stained schist with quartz lenses
4. Ironstained quartzite
5. Quartz-bearing gossan
6. Barren quartz and schist.

The crop extends eastwards for only ½ ch. beyond the cut, but another occurs on the line of strike in the adjoining lease.

Chinaman Extended (M.L. 551).

Mgr., Miller.

LOCATION, ETC.

The Chinaman Extended adjoins the freehold on the east.

The area is 10 ac. Deserted when visited.

DEVELOPMENT.

The shaft, which is 20 ft. deep, lies 5 ch. easterly from the Company's cut. It was inaccessible, but is believed to have a crosscut to the south at the bottom.

ORE-BODY.

The shaft is located on the northern side of a small quartz blow, on the line of the Chinaman crops. The material on the dump from the shaft and crosscut is quartzite, with a little schist, both slightly stained by malachite and containing perhaps 2% copper.

To the north of the shaft there is a strong crop of schist, in which are scattered granules of quartz, giving it the appearance of an amygdaloidal volcanic rock.

Celestial (Extended M.C. 195).

Mgr., Ford.

LOCATION, ETC.

The Celestial lies about 2 miles south-south-west of the blast furnace on Mount Start, and 1 mile west-south-west of Duck Creek and the Chinaman freehold.

This is four men's ground—1,600 ft. × 350 ft. It was first held as a mineral selection. Early in this year it was reported to have been acquired with the Speculation and Horseshoe by the Celestial Copper and Option Co., Ltd.

DEVELOPMENT.

The main shaft, which is 30 ft. deep, lies midway between the eastern and western boundaries and 1 ch. from the northern. An inaccessible underlie shaft, No. 2, lies 350 ft. to the west 14° south, is 30 ft. deep and has a crosscut running 7 ft. to the north at the bottom. Its dimensions at the surface are 10 ft. by 6 ft. and at the bottom 7 ft. × 5 ft.

OUTPUT.

1906 ... $4\frac{13}{20}$ tons shipped by Salveson (source doubtful).

ORE-BODIES.

The ore-bodies occur on the continuation of the Chinaman-Speculation zone, here striking east 17° north, but there is a gap of over half a mile between this lease and the freehold. Within 10 ft. east of the main shaft the formation is made up in great part of lenticular masses of quartz in schist producing a bold crop, 10 ft. wide and 1½ ch. wide. There being no siliceous crop to the west copper ore may be found in that direction. Besides the cupriferous areas at the shafts, there is a small rich patch of ore ½ ch. west of the main shaft and a poor patch 1½ ch. west, a third body of 15% ore cropping 1 ch. beyond the last.

No. 2 shaft was sunk on the southern side of a small blow. One small bunch of rich malachite-bearing tile-ore was cut in the eastern end of the shaft but most of the sinking was on a schist footwall in slightly cupriferous quartzite with numerous crystal-lined vugs, rather unusual in this district. The crosscut proved 18 in. quartz of no value.

In the upper part of the main shaft a width of 9 ft. of formation, dipping 5 in 1 h. to the south is exposed, between walls of schist. The footwall is well defined, is internally slickensided, and has every appearance of permanency. On the hanging-wall there is 9 in. to 18 in. of quartz, then 6 in. gossany material (*a*) and 2 ft. 6 in. malachite-stained schist, followed by 9 in. to 2 ft. of quartz, then 2 ft. of malachite-stained schist and 18 in. of quartz and gossan (*b*) on the footwall. At the bottom the shaft is contracted in size but, owing to the pinching out of the bands of schist and quartz, both of the gossany veins (*a* and *b*) are exposed. The former is 6 in. wide and consists of 6 in. earthy gossan, well worth sinking on; and the latter of 12 in. of copper-stained quartz.

The formation towards the surface could, without trouble, be picked to run 10% copper, crystallised azurite being fairly plentiful, but practically, the whole of the material raised from the shaft is cupriferous. About 30 tons of quartz, carrying perhaps 2% copper, have been thrown aside from the tip, which now contains about 120 tons. A surface sample of this ore consists of: black chloritic schist, stained by malachite along its laminations; quartz in lenticular form, with an external film of malachite; and cellular gossan and tile-ore, in which are distorted crystals of limonite, pseudomorphous after chalcopyrite, replacing schist. Assay results as follows (Government Analyst):

Copper	=	4·3 %
Gold	=	20 gr. per ton
Silver	=	1 dwt. 10 ,, ,,

A second line on which no work has been done crops about 12 ch. south of the Celestial. About midway between the two lines is a crop running west-south-west of amygdaloidal rock referred to above. (*See* under Commonwealth).

Speculation (M.C. 198).

Mgr., Leonard.

Location, Etc.

The Speculation adjoins the Celestial on the east.

The area is 1,200 ft. × 350 ft. This claim was reported in the Press (16-1-07) to have been taken over, with the Celestial and Horseshoe, by the Celestial Copper and Option Co., Ltd.

Development.

The workings comprise a shaft, 15 ft. deep, near the eastern boundary; a shaft 12 ft. long, 5 ft. wide and 10 ft. deep, 3 ch. from the western boundary; a cut ½ ch. west of the first shaft; and two other cuts 2 ch. and 2½ ch. west of the second shaft, 10 ft. and 6 ft. deep respectively.

Ore-bodies.

The excavations all expose schists and lenticular quartz veins, dipping steeply southwards, and some of them bands of gossan as well.

The eastern shaft gives a good idea of the nature of the crush-

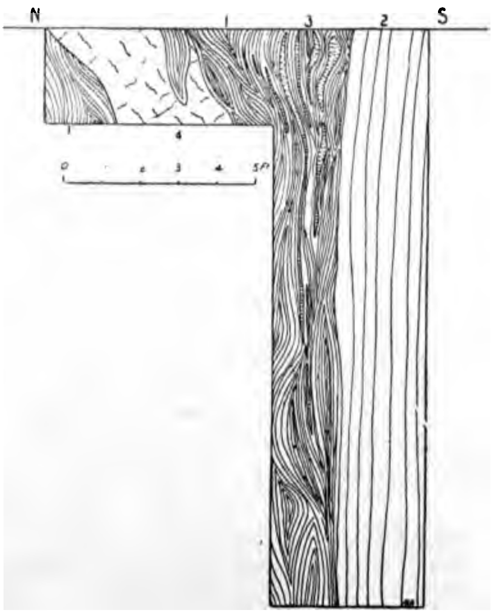


Fig. 17.—Section of formation, eastern shaft, Speculation claim.

1. Schist | *3. Schist with quartz lenses*

2. Slate | *4. Quartz.*

zones, in which lenticular bodies of quartz occur in schist. (Fig. 17.) Only 2 tons of cupriferous quartz and schist, carrying not more than 5% copper, have been paddocked.

In the adjoining trench to the west the exposure is rather better, there being two 6 in. bands of ferruginous schist and formation separated by 3 ft. of schist, between the quartz-bearing formation and the hanging wall slate. (Fig. 18.) The ore raised from here is very ferruginous as well as siliceous and the 6 tons paddocked should yield 15% copper.

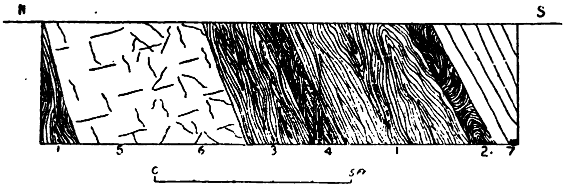


FIG. 18.—SECOND TRENCH, SPECULATION CLAIM.

1. Schist
2. Ferruginous schist
3. Cupriferous schist with quartz lenses
4. Reddish formation
5. Quartz
6. Broken quartz
7. Slate.

The quartz of the crop, just to the west of these workings, exhibits horizontal corrugations resembling slickensides on a large scale, and apparently produced in the country rock during the crushing movement prior to or during the segregation of the quartz.

The only cupriferous crops between the two shafts are at 3 and 5 ch. distance from the eastern. At the former spot a few tons of malachite-bearing schist, carrying 10% copper, have been dug out.

The western shaft exposes a cupriferous formation 12 ft. wide, dipping (judging by the footwall schist) 3 in 1 h. to the south. The section is as follows, beginning at the hanging-wall altered slate: 2 ft. cupriferous schist and quartz; 2 ft. 6 in. cupriferous quartz; 6 in. cupriferous gossan; 18 in. poor quartz; 2 ft. 6 in. cupriferous quartz and schist; 18 in. cupriferous quartz. Rejecting the quartz the formation in the shaft appeared likely to bulk over 10% copper as carbonate. My sample from the whole length of the eastern face consists of crystalline and granular quartz and schist. The granular quartz contains flakes of schist and is stained by malachite, which also occurs in acicular form in cavities with hydrous iron oxides. The schist is also to some extent stained by malachite and hydrous iron oxides. The sample was assayed as follows (Government Analyst):

Copper	=	**3·0 %**
Gold	=	**trace**
Silver	=	**2 dwt. per ton.**

The first cut to the west of the last shaft exposes 6 ft. cupriferous formation between quartz lenses forming foot- and hanging-walls. It appears likely to average 10% copper. The 10 tons of ore paddocked comprise schist and quartz, with malachite and tile-ore, and are likely to yield 20% copper. This is worth further development.

The westernmost cut exposes 7 ft. width of cupriferous and ferruginous formation, likely to run 5% copper, chiefly as malachite, but there are some films of chrysocolla here also. The hanging-wall is slate, adjacent to it is 12 in. cupriferous schist, and then 12 in. barren schist, then 18 in. cupriferous schist; and adjacent to the footwall schist is 18 in. ferruginous and siliceous gossany schist, worth sinking, at least a shallow shaft on.

There is thus no defined lode here, but rather a crush-zone very siliceous and low in grade in the best parts, the copper being irregularly distributed.

A parallel crop, 7 ch. to the south of the above, has been tried in one place, where there is 2 ft. of quartz with gossan and a little copper ore. A little over 1 ton of 30% ore was shipped from here (by Salveson and Leonard).

Speculation West (M.L. 428).

Mgr., Weir.

Location, Etc.

The Speculation West adjoins the Speculation Claim (not the lease) on the west.

The area is 9$\frac{8}{10}$ ac. Exempt when visited.

Ore-bodies.

The crop worked in the adjoining claim continues for over a chain into the lease, but no work has been done and no ore is exposed.

EVA GROUP.

The Eva, Jessie, Phœnix, Commonwealth and possibly the Captain are all on one or other of two lines, the Huia and Weka being somewhat to the south.

Eva (M.L. 250).

Mgr., Matheson.

Location, Etc.

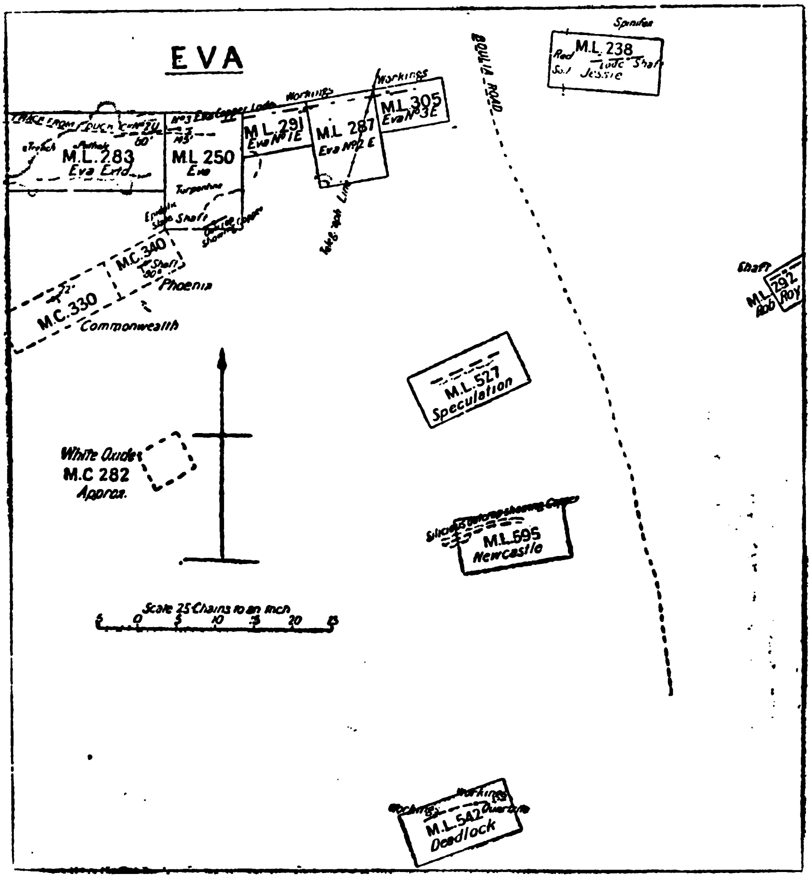
The Eva is a little over ½ mile east of Duck Creek and 1¼ mile south-east of the blast furnace on Mount Start, which is 22½ miles south-south-west of Cloncurry.

The area of the lease is 15 ac., and it is the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

No. 3, the whip-shaft, 8 ft. × 3 ft. in the clear, is 300 ft. to the east 5° north. It is vertical to a depth of 120 ft. and below that underlies with the lode 7 in 1 h. for 25 ft. Water was standing in it 95 ft. below the surface and the ladders having been removed no inspection could be made. The absence of any quantity of free acid or mineral matter in solution is to be inferred from the fact that the water from this shaft was used for culinary purposes during the late drought.

The only other shaft is near the southern boundary of the lease, and now 12 ft. deep, underlying southwards. Since my visit this has been deepened to 50 ft., where drives have been opened 18 ft. east and 17 ft. west.



ORE-BODIES.

The northern ore-bearing zone, on the line of which are the workings in the Extended and Nos. 1, 2, and 3 East, crops, in the north-eastern corner of this lease, as iron-stained quartz with a little oxide-carbonate ore.

The whip-shaft has proved the lode, below 120 ft. depth, to underlie 70° to the south, the hanging-wall country being blue slate. Mr. Matheson informed me that the lode at the bottom is well defined and larger, but much poorer, than at the surface, there being 4 ft. width of quartz in places.* The ore, of which there are 70 tons paddocked, comprises schist and slate, interlaminated and replaced by quartz and pyrite, with a little tile-ore, azurite and chalcocite. That last raised shows cupreous pyrite in the gossany parts of a quartzose chloritic rock.

A rough sample taken from the surface of the paddock contains: greenish chloritic schist, both barren and cupriferous (malachite); barren crystalline quartz; loosely aggregated crystalline malachite; cellular gossan and limonite with disseminated chalcocite; chalcopyrite interstitial in the quartz; chalcopyrite minutely reticulated with chalcocite; and a little ferruginous granular calcite slightly stained by malachite. The assay return is as follows (Government Analyst):—

Copper	=	13·3 %
Gold	=	1 dwt. 4 gr. per ton
Silver	=	1 ,, 10 ,, ,,

The southern ore-body strikes east-north-east and dips steeply south-south-east. The crop is schist, with lenticular bodies of quartz only slightly stained with malachite and iron oxides. In the shaft the footwall schist is much slickensided internally, but no defined hanging-wall has yet been reached. The ore thus would appear to be in a crush-zone. Near the surface the ore-body was 2 ft. 6 in. wide, but in the sump it is 3 ft. across. The ore consists of an intergrowth of tile-ore and malachite, some of it very siliceous, crystalline quartz forming the greater part of the ore-body in places. About 20 tons have been paddocked and are expected to average 12% copper. The mullock amounts to only 3 tons.

The manager has reported since my visit that, at 20 ft. depth, there is 2 ft. 6 in. of 12% ore; at 28 ft. depth, 2 ft. 6 in. of 14%; at 34 ft., 12%; 38 ft. depth, 4 ft. of siliceous 12% ore; at 43 ft. depth, the full width of the shaft runs 12%; and at 50 ft. depth "a big body of siliceous ore" containing 12% copper. Further he reports that the drives were opened in 3 ft. of siliceous ore. In the eastern drive, at 12 ft. from the shaft, there is 2 ft. 6 in. very siliceous ore, but, at 18 ft., only 18 in. copper-bearing quartz. In the western drive, at 12 ft. from the shaft, the full face is fair quality ore and, at 17 ft., there is 4 ft. of siliceous ore (27th May, 1907).

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* This has been reported to the Warden as unpayable.

Eva Extended (M.L. 283).

Mgr., Matheson.

LOCATION, ETC.

This lease adjoins the Eva on the west.

The area is 20 ac. It is the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

A cut has been opened a few chains from the western boundary; there is a pothole near the centre of the lease; and the main shaft, known as the No. 2, is in the north-eastern corner, 300 ft. from the No. 3 shaft in the Eva. No. 2 shaft, 7 ft. × 3 ft. in the clear was sunk on an underlie of 4 in 1 h. to the south to a depth of 80 ft., and drives were then opened 23 ft. east and west.

ORE-BODIES.

The western cut was opened in quartz and limonite rubble and malachite-stained clay. The bottom cannot now be seen, but between 3 and 4 tons of siliceous ore, carrying tile-ore and malachite, have been stacked here. This ore carries at least 50% silica and only 10% copper.

In No. 2 shaft the average size of the ore-body is 12 in. to a depth of 20 ft., where it pinches to 2 in., gradually increasing again to 18 in. In the end of the eastern drive there is 9 in. gossan and, in the end of the western, 3 in. gossan with some lenses of calcite, both faces being poor in copper but promising in appearance. There is 8 in. width of good ore nearer the shaft on each side. The hanging-wall country is slaty or blocky schist, while the footwall is formed of typical chloritic schist, much slickensided near the ore owing to crushing. Flakes and lenses of the rock are found all through the ore-body, showing that the metallic minerals have been deposited not in an open fissure but rather in a crush-zone.

There are 10 tons of ore at grass from this shaft—comprising schist altered and replaced and containing gossan, malachite and tile-ore—expected to run over 30%. My sample consists of: dark-green chloritic schist, gossany in part and also replaced by tile-ore, malachite and glance stained by malachite; cellular gossan with impregnations of malachite; glance stained by malachite and containing original chalcopyrite; much granular quartzite with chlorite of the original schist; some barren quartz; and a little calcite. The Government Analyst has assayed it for:

Copper	=	20·8 %
Gold	=	1 dwt. 14 gr. per ton
Silver	=	5 ,, ,,

Eva Nos. 1, 2 and 3 East (M.L. 291, etc.).

Mgrs., Hulbert, Entricken and Byrne.

LOCATION, ETC.

These leases have been taken up in order adjoining and to the east-north-east of the Eva.

The No. 1 East (M.L. 291) has an area of 5 ac.; No. 2 East (M.L. 287) has an area of 10 ac.; and No. 3 East (M.L. 305) has an area of 5 ac.

DEVELOPMENT.

The workings on the No. 1 and No. 2 East are on the dividing line and those on the No. 3 East are in the western part. They comprise old shafts and open-cuts, which have been long idle and have collapsed.

ORE-BODIES.

The ore bodies worked appear to be on the continuation of the main Eva crush-zone.

OUTPUT.

1904	..	11	tons shipped by	Brady,	carrying	$32\frac{1}{2}$ %	copper
		6	,, ,,	Woodgate,	,,	35 %	,,
1905	...	8	,, ,,	Brady			
		$3\frac{18}{20}$	,, ,,	Woodgate			
1906	...	3	,, ,,	Wilmot			
		$31\frac{18}{20}$					

Jessie (M.L. 238).

Mgr., Matheson.

LOCATION, ETC.

The Jessie lies $\frac{3}{4}$ mile east-north-east of the Eva, just beyond the Boulia road. The surface here is a flat rolling peneplain, the soil being red and gravelly.

The area is 10 ac. The lease is the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

One shallow hole had been opened, in October last, in the centre of the eastern half of the lease, and besides it there were unsuccessful trenches $1\frac{1}{2}$ ch. and 3 ch. to the east.

The managers' reports, since my visit, state that a shaft was begun in November last, and at the end of the year was 44 ft. deep. It has been continued to 50 ft. and a drive, opened eastwards, was 30 ft. long at the end of March. Sinking was then resumed.

OUTPUT.

1904 ... $24\frac{18}{20}$ tons shipped.

ORE-BODIES.

The crop, which strikes east and west, dipping 80° to the south, can be followed for $\frac{1}{2}$ ch. west of the hole (with traces for $2\frac{1}{2}$ ch.

beyond) and for 10 ft. to the east in schist country. It is formed of limonite and quartz in which malachite stains appear immediately under the surface. There has been a slight deposition of secondary chalcedonic mammilated silica on some of the ore, since its oxidation to limonite, which has also in a few places been rendered cherty.

In the hole is exposed 3 to 6 ft. of quartz, cemented by limonite, some of it gossany and stained by malachite. This ore contains over 50% silica and probably less than 10% copper in the richest parts.

In the shaft sunk since my visit, the manager reports that the ore-body at 12 ft. depth is 3 ft wide and assays 21% copper; and, in sinking 12 ft., 20 tons of 21% ore were raised. At 24 ft. depth it is 2 ft. wide and 10 tons of 33% ore were raised in sinking 12 ft. Between 24 and 36 ft. the sinking was in siliceous ironstone (said to be hæmatite in one report) of no value, but at 44 ft. depth it showed an improvement, and was 4 ft. wide (29-12-'06). To 50 ft. it continued 4 ft. wide but was still low in copper. Rich ore, 25 to 30% copper, was struck in the eastern drive at the 50 ft. level 4 ft. wide, at 24 ft. from the shaft—15 tons of 25% ore were broken down in driving from 14 to 24 ft. and 10 tons of 30% ore in driving from 24 ft. to 30 ft.

At 54 ft. in the shaft there is 2 ft. 6 in. width of ferruginous quartz; and at 58 ft. there is 18 in. siliceous gossan (27-5-'07).

Phœnix (M.C. 340).

Mgr., Walsh.

LOCATION, ETC.

The Phœnix adjoins the Eva on the south-west.

This is three men's ground—600 ft. by 350 ft. It was deserted when visited.

Only one shallow shaft has been opened here.

ORE-BODY.

The ore-body here exposed is on the line of that being proved in the southern shaft on the Eva lease, the strike being east 30° north. In the shaft 3 to 5 ft. width of cupriferous formation can be seen, dipping 80° to the south-south-east. The formation is chloritic schist, with much quartz and impregnated with malachite, tile-ore, and a little chalcocite. About 4 tons of firsts running 10 or 15% copper have been paddocked, the seconds, carrying 5% copper, amounting to 3 tons.

The work done here is of no importance except that it proves the southern crush-zone on the Eva to continue for at least 10 ch. to the west-south-west.

Commonwealth (M.C. 330).

Mgr., Artz.

LOCATION, ETC.

The Commonwealth claim adjoins the Phœnix on the south-west. This is five men's ground, 1,000 ft. × 350 ft.

DEVELOPMENT.

Work had only just commenced here in October last, the first shaft near the centre of the claim being 22 ft. deep, and a start having been made on a second, $1\frac{1}{2}$ ch. to the east-north-east, when visited.

OUTPUT.

1906 ... 4 tons shipped.

ORE-BODY.

The ore-body exposed in the shaft is rather to the north of the line of strike of those in the Phœnix and the southern part of the Eva. Its strike is east 35° north, which would carry it much to the north of the workings on the above line; but its dip is 3 in 1 h. to the south-eastwards.

The ore here is tile-ore, chalcocite (glance) and malachite, with just a trace of chrysocolla. It occurs in the crushed hanging-wall country for 2 ft. from a quartz vein 2 ft. 6 in. thick. No considerable body of ore has yet been found, but there is a possibility of the amount increasing as the quartz pinches out. Only 1 ton of firsts (20% ore) had been bagged, the seconds (10% ore) produced being 3 tons.

A little chalcopyrite-chalcocite-limonite has been found in the eastern hole.

The footwall country is a hard silicified schistose rock, much crushed towards the shaft bottom and there showing internal slickensides. In this neighbourhood are found besides schists highly altered rocks, in which segregation of quartz and calcite has taken place, giving them some resemblance to amygdaloidal volcanics.

Captain (M.L. ?).

Mgr., Bushnell.

LOCATION, ETC.

The Captain lies on the western bank of Duck Creek, 2 miles south of the blast furnace on Mount Start.

A 10-ac. lease was to be applied for, but in October, 1906, the papers had not been sent in. The ground was formerly held as the Watercourse by Madden.

DEVELOPMENT.

The holders of the Watercourse opened one trench in 1904. The new shaft, which was only 10 ft. deep when seen, is located below the bank of the creek and likely to be flooded during freshes.

OUTPUT.

1906 ... 3 tons shipped.

ORE-BODY.

The strike of the ore-body is east 33° north, the ore replacing schist in a crush-zone—quite possibly a continuation of the southern Eva-Phœnix-Commonwealth. The country rock is a blocky slate the joints of which are coated with a white calcareous powder. It forms a smooth hanging-wall dipping 3 in 1 h. south-eastwards. East of the workings the country is a hard dark chloritic slaty rock, with thin siliceous bands almost free from chlorite but containing occasional granules of chalcopyrite. It is locally known as diorite.

The formation at the north-eastern end of the shaft is 5 ft. wide, there being 6 in. of quartz, with strong stains of malachite and azurite and bunches of tile-ore, on the hanging-wall; then 6 in. high-grade, sometimes nearly pure, chalcocite (glance) ore with quartz; then 9 in. cupriferous (radiating malachite) gossan; then 4 in. chalcocite and quartz; then 12 in. chloritic schist and then siliceous cupriferous (chrysocolla) gossan and gossany quartzite to the foot-wall. In the south-western end a horse of schist splits the ore-body into two legs 2 ft. wide and 4 ft. apart.

There was about 6 tons of unpicked ore at grass, and it may be expected to carry at least 20% copper; the bagged ore—chalcocite, tile-ore and malachite with a little quartz—amounts to 1½ tons and should yield 40% copper.

Huia (Extended M.C. 270).

Mgr., Michail.

LOCATION, ETC.

About ½ mile south-east of the Captain.

The area is 800 ft. × 350 ft. Since abandoned.

One opencut has been excavated here but has now fallen in.

Weka (M.C. ?).

Mgr., Higgie.

LOCATION, ETC.

The Weka lies about ¾ mile south-east of the Captain and ¼ mile north-west of the Deadlock.

The area is 200 ft. × 350 ft. The ground had not yet been applied for when visited.

Work had just commenced here, only one trench having been opened.

Output.

1906 ... $\frac{15}{20}$ ton shipped by Higgie.

Ore-bodies.

The ore-body being opened up is 9 to 12 in. wide and carries malachite, chrysocolla, dioptase (?) and a little atacamite, about 1 ton of such ore being paddocked. The country rock near the ore-body is a blocky schist, almost free from quartz veins. Some radiating black tourmaline was found in the altered sedimentaries ½ ch. south of the cut.

About 15 ch. south-east of the Weka workings there is a cut along a crush-zone running north 30° west, in very ferruginous and rather siliceous copper-bearing material.

WHITE OXIDE GROUP.

The White Oxide appears to be on the continuation of the Speculation and Rob Roy crush-zone, the Newcastle being on a parallel zone to the south.

White Oxide (M.C. 282).

Mgr., Ford.

Location, Etc.

The claim is ½ mile west-north-west of the Newcastle.

It embraces two men's ground—400 ft. × 350 ft.

The shaft, in process of sinking, is now 20 ft. deep (October, 1906).

Ore-body.

The strike of the ore-body is east-south-east, the dip being 1 in 1 to the south-south-west, and it is therefore believed to be on the Rob Roy crush-zone. The cupriferous crop, in which the shaft is sunk, can be traced to a large blow of quartz 1½ ch. to the west.

A formation 2 ft. 6 in. wide, with well-defined hanging-wall, to be seen in the shaft, consists of altered slate, tile-ore, malachite and a little quartz. The firsts bagged amount to 4½ tons and are expected to yield 30% copper, while the 2½ tons seconds should yield 10%.

The dark crystalline rocks, in the vicinity of the shaft, have the appearance of certain intermediate eruptives, but, until a microscopic examination has been made, the country is to be considered of sedimentary origin, though highly metamorphosed.

Speculation (M.L. 527).

Mgr., Miller.

LOCATION, ETC.

The Speculation lies about ½ mile west-south-west of the Rob Roy and the same distance south-east of the Eva.

The area is 10 ac. It was not inspected by me.

ORE-BODY.

The Speculation is on the Rob Roy zone.

Rob Roy (M.L. 292).

Mgr., Sleight.

LOCATION, ETC.

This lease is a little over ¼ mile south-east of the Jessie.

Its area is 5 ac.

Only one shallow shaft has been sunk.

OUTPUT.

1904 ... 22 tons ore shipped, carrying 30 % copper (source doubtful).

ORE-BODY.

A quartz and schist zone strikes east 30° north as on the Eva (south).

Newcastle (M.L. 595).

Mgr., Harvey.

LOCATION, ETC.

The Newcastle lies about 2 miles south-east-by-south of the blast furnace on Mount Start and 10 ch. west of the Boulia road.

The area is 10 ac.

Only one or two potholes have been opened here.

ORE-BODY.

The crop is schist and quartz, with patches carrying malachite, presumably on a shear-zone striking east-south-east, and the same as that being tested on the White Oxide. Very little ore is visible here.

ALICE GROUP.

The Alice, Deadlock, Iron Duke and Mount Surprise are included in one group for convenience in describing, though they have no apparent connection.

Alice (M.L. 717).

Mgr., F. H. Green.

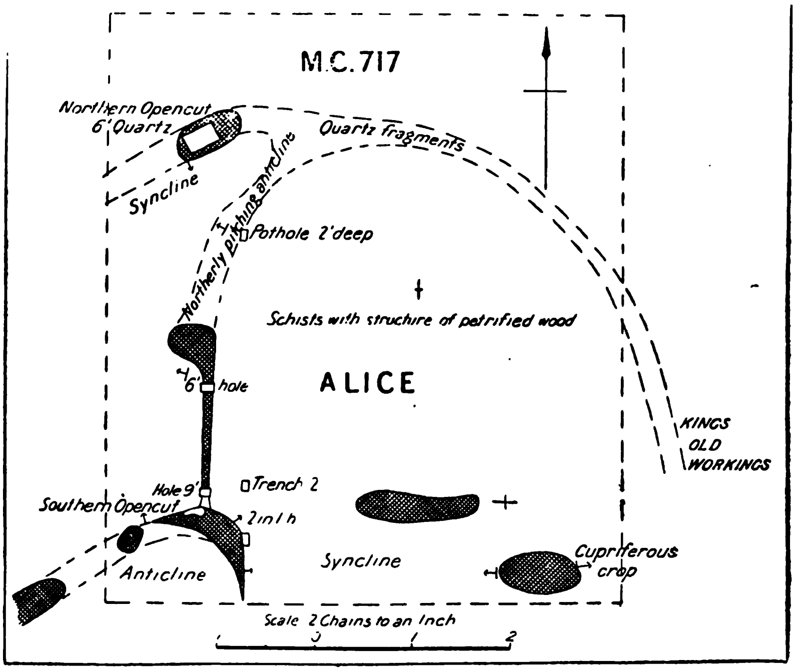
LOCATION, ETC.

The Alice lies 1 mile south 40° east from the Rob Roy, and 1 mile east of the Boulia road, 1½ miles north-east of the Duck Creek crossing.

The area is 20 ac. When visited the ground was held as an extended claim (M.C. 73)—one man's ground. It was first taken up 30 years ago as a mineral selection.

DEVELOPMENT.

The workings comprise: two opencuts, one in the south-western corner being 10 ft. long, 5 ft. wide and in parts 8 ft. deep, the other, in the north-western corner, being 15 ft. by 10 ft. and 4 ft. deep; a trench (No. 2), 25 ft. north-east of the southern opencut; and four potholes; No. 1, about 20 ft. east of the southern opencut; No. 2, 9 ft. deep a few feet to the north of the cut; No. 3, 6 ft. deep × 10 ft. long 1 ch. to the north, and No. 4, 2 ft. deep, 1½ ch. beyond.



OUTPUT.

1904	...	23	tons shipped by Green (source doubtful).
1905	...	7	,, ,, ,,
1906	...	$7\frac{12}{20}$	,, ,, ,,
	Total	$37\frac{12}{20}$*	

The Wardens have also recorded the following shipments from the adjacent Rainbow claim:

1904	...	6 tons shipped by Laws and King
1906	...	6 ,, ,, King and Davis.

ORE-BODIES.

The greater part of the Alice is underlain by a flatly undulating body of quartz, only the uppermost parts of the anticlines reaching the surface. The underlying rock is a soft grey decomposed slate, the overlying rock, to which the quartz is often "frozen," being kaolinised schist with a coarsely fibrous structure, as in some specimens of petrified wood.

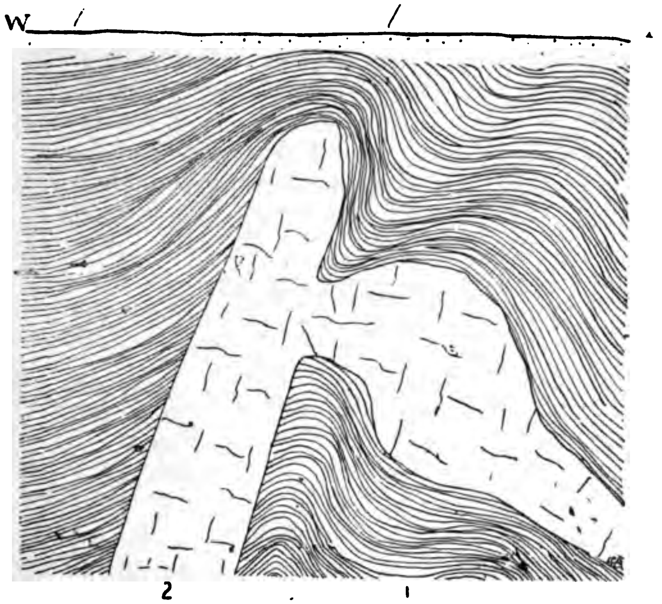


FIG. 19.—SECTION IN END OF NO. 2 TRENCH, ALICE.

Scale: 1 ft. to an inch.

1. Schist | *2. Quartz.*

In the southern opencut the quartz body is almost horizontal, dipping flatly (½ in 1 h.) east, north and north-west, wherefore the body appears much larger than is actually the case. Bunches of gossan, tile-ore, malachite and chrysocolla—the last two filling in a siliceous skeleton, and the malachite also in radiating masses, up to 3 in. in diameter, encrusted by a thin film of secondary silica or by chrysocolla—are scattered irregularly, through the quartz, more especially about 2 ft. under the hanging-wall. The whole width would average less than 2% copper, but it should be possible to work the malachite-bearing bands apart from the quartz, which was first worked for gold, specks of the metal being often seen in breaking up the stone. There are 2 tons of firsts, containing 40% copper, ready for shipment, besides 1 ton of seconds, containing 30%; and 3 tons of very siliceous thirds, containing 10% copper.

---

* Mr. Green informed me he had shipped 25 tons of ore, yielding 35 to 49·7 % copper, and that 5 tons of 40 % ore had been shipped by Brady.

Trench No. 2 exposes a 12 in. quartz vein, which cuts across the strata and yet does not reach the surface, being evidently a spur from the main body. (Fig. 19.)

A 4 ft. vein and spur, with ill-defined walls dipping 3 in 1 h. to the west, are exposed in No. 3 hole. One quarter of this is cellular gossan, with a fair staining of malachite and chrysocolla, and the remainder is quartz. This is one of the best faces seen in the district, and some very good ore is said to have been raised.

The northern opencut shows 6 ft. quartz and cellular gossan. The hanging-wall country is very micaceous and gossany, with malachite near the surface. Some good ore has been also obtained on the footwall. This crop is well worth sinking on, because of the cellular gossan, which is likely to give place to copper-bearing pyrite in depth. About 1½ ton of 36% ore has been shipped from here.

Deadlock (M.L. 542).

Mgr., Allis.

LOCATION, ETC.

The Deadlock lies about 1¼ mile south-east of the Eva, and ¼ mile west of the Boulia road.

The area is 10 ac. It was deserted when visited in October last.

DEVELOPMENT.

The main shaft is 30 ft. deep and inaccessible; the only other workings are potholes, 30 ft. east and 30 ft. west of the shaft.

OUTPUT.

Total ... 30 tons shipped—30 % copper.

ORE-BODIES.

Quartz and quartzite, with occasional bunches of ore, form a blow, a chain long and 8 ft. wide, just to the east of the workings.

Quartz crystals, up to 3 in. across, with some secondary jasper, line a central cavity in the blow. Malachite-bearing gossan appears at the eastern end of this crop, but has not yet been broken into.

The potholes expose formation similar to, but poorer than, that in the shaft, where it is 3 ft. wide and dips 5 in 1 h. to the south, the strike being east and west. The formation comprises schist and quartz, with malachite and tile-ore, and this material practically forms the whole of the dump. It should not be a difficult matter to raise the copper content in this to 15% by picking out barren quartz. The seconds at grass amount to 10 tons and should yield 20% copper.

Mount Surprise (M.L. 301).

Mgr., King.

Location, Etc.

Mount Surprise lies ¾ mile south-south-east of the Alice, 1 mile east of the Boulia road and 3¾ miles south-east of the blast furnace on Mount Start.

The area is 10 ac. Deserted in October.

No work has yet been done here. The zone could easily be proved by adits, but does not appear to be worth it.

Ore-bodies.

There is here a north-east and south-west striking crush-zone, somewhat similar to the Tharsis, vertical lenses of quartz and occasional patches of malachite-bearing rock occurring in schist over a width of 30 ft. The strike is north-east and south-west. The siliceous nature of the crop has enabled it to more successfully resist denudation than the surrounding country, and it consequently now rises some 50 ft. above the general level of the plain.

Iron Duke (M.L. ?).

Mgr., Orchard.

Location, Etc.

The Iron Duke is about ½ mile west of Mount Surprise.

The area is (?) ac. The ground had only just been pegged out when visited, and the lease application had not yet been granted.

Two potholes have been opened, 30 ft. apart.

Output.

Total ... 3 tons shipped by Brady (*fide* Mr. Ford).

Ore-bodies.

The north-eastern hole exposes a gossany formation 6 in. to 2 ft. wide, dipping 70° to the south-west.

The south-western hole is at the intersection of spurs from the north-east and west with a north-west striking vein of quartz.

There is also a formation, 3 ft. wide, in which are lumps of calcite and copper ore, together with much cellular gossan. This is worth sinking on. The ½ ton of firsts at grass should yield 30% copper. The ½ ton of seconds contains a chalcopyrite mosaic in limonite cementing fragments of crystalline quartz, the oxidised copper having crystallised in cavities as malachite.

A third crop, 1 ch. to the south-west, shows 5 to 6 ft. of quartz with some gossan, but it has not yet been broken into. Its general strike is north-west and south-east, but there are several slight bends.

There is, ½ ch. to the south-west of the last, a fourth parallel crop, on which no work has been done.

TAMBOURINE GROUP.

The Tambourine Group lies midway between the Duck Creek and Corella Groups, and, being on Duck Creek waters, is included with the former. The ore-bodies seen are unimportant in size, and, occurring on bedding planes, are not promising, but their association with the boro-silicate tourmaline is to be noted as being indicative of a deep-seated origin.

Tambourine (R.C. 286).

Mgr., Brockett.

LOCATION, ETC.

The Tambourine is located on one of the head branches of Duck Creek, 26 miles south-west of Cloncurry and 3 miles north of the Duck Creek-Corella road. It is in low open rolling country just to the south of a precipitous range.

Its area is 80 ac.

DEVELOPMENT.

One shaft has been sunk near the centre of the claim to a depth of 20 ft., but, being in the creek bed, was full of water when visited. Only one other pothole, a few feet deep, has been opened on the outcrop.

OUTPUT.

1906 ... 8 tons shipped.

ORE-BODIES.

Several lines of crop have been found on the claim, but only that proved by the shaft is of any economic importance. This comprises isolated bunches of ore in marl-bearing schists and highly altered slates, the ore consisting, as proved in the pothole, of schist and black quartz stained more or less by malachite. The general strike is north 36° east, which appears to be that of the country rock.

The shaft is on an 18 in. crop of gossan, and chalcopyrite, chalcocite and pyrite were met towards the bottom. The firsts shipped included 25 bags of malachite in fine radiating nodular masses, free of visible impurity except silica, which has been deposited as thin coats round the nodules. The 3 tons of seconds at grass probably carry 10% copper, and consist in great part of cellular siliceous gossan in which can be distinguished casts of the original pyrite. Secondary silica is present in some quantity with chrysocolla, and both malachite and azurite are to be seen. The gossan cannot be followed for many yards and most of the copper is therefore probably limited to the one shoot, quartz with little copper occurring on the line to the south-west. The association of tourmaline (schorl) with this quartz is interesting as it is indicative of pneumatolysis having played some part in the genesis of the ore-body. (Cf. the Weka at Duck Creek, etc.) Near the centre of the southern line of the lease there are numerous patches of quartz stained by malachite and containing limonite and tourmaline, the country here being a jointed micaceous slate. Between the main line and these outcrops many bunches of quartz have been located on the bedding planes of the country rock.

Tambourine South (M L. 536).

Mgr., Brockett.

Location, Etc.

This adjoins the Tambourine claim on the south-west.

Its area is 10 ac.

No work has been done on this lease, and it is likely to be surrendered, as no indications of ore-bodies have been found on it.

Banjo (M.L. 590).

Mgr., Smith.

Location, Etc.

The Banjo is located on the northern side of a ravine, in the range ½ mile north of the Tambourine.

Its area is 5 ac.

Development.

Two shafts have been opened in the north-western part of the lease. The lower shaft is 20 ft. deep, and the upper, which is 25 ft. to the east, is 10 ft. deep.

Output.

1906 ... 16 tons ore shipped.

Ore-bodies.

Two parallel ore-bodies, 20 ft. apart, have been exposed here, with a north-east strike and a steep dip to the south-east. The country rock is schist and slate, the general strike of which in the range to the north is north-east and south-west, the apparent dip of the schists being to the north-west, while that of the slates is to the south-east. This is presumably due to induced cleavage, but may be accounted for in some degree by folding.

At the lower shaft slates exhibit a north-and-south cleavage, and the ore-bodies consequently give a false impression of being on a true fissure, although the walls are not well defined. Near the surface only 6 in. of quartz and ferruginous kaolinised slate can now be seen, but chrysocolla was found in some quantity in the upper part of the shaft in one specimen obtained, replacing fibrous malachite and retaining its structure; and pyrite and chalcocite-veined chalcopyrite are showing in the bottom, where the lode is nearly a foot wide. The richly cupriferous shoot is evidently not more than 5 ft. in length. The firsts bagged from this shaft amounted to 10 tons, and the seconds to 2 tons. The former included malachite, chrysocolla, and glance-impregnated chalcopyrite, and the latter carried 5% copper chiefly as chrysocolla.

The upper shaft exposes a vein of copper ore, ½ in. to 3 in. wide, between jointed chloritic schist on the north-west and ferruginous quartzite on the south-east, the latter probably an original bed. On the northern side of the shaft the vein pinches to 1 in. (chiefly chrysocolla), but there is said to be 3 in. width of ore below the mullock in the shaft bottom. The firsts, of which 6 tons have been shipped, carry very finely divided native copper in tile-ore. About 1 ton of seconds—siliceous limonite with chrysocolla malachite and dioptase (?)—are at grass and are believed to carry over 10% copper.

SLATY CREEK.

The ore-bodies seen within the catchment area of Slaty Creek above the Gorge Hotel are, with one or two exceptions, characterised by an east and west strike. The country is highly metamorphosed and the quartz, limestone and copper ore-bodies are typically lenticular in form, being especially well developed on the flat country west of the Two-Mile well, which is itself sunk in highly altered slate veined with quartz and calcite. The limestones may be organically derived and therefore original strata, or may, like the quartz, have segregated during the progress of the metamorphism. The copper ores may also in part have been concentrated from originally cupriferous country, but the pneumatolytic mineral, tourmaline, found on McEvoy's claim with bismutite, points to another source—*i.e.*, a deep-seated igneous magma. As bearing on the general geology of the Slaty Creek, a note should be made of the crystallisation of quartz in ferro-calcite, almost as in graphic granite, about ½ mile south of the Brilliant, somewhat similar to the occurrence at Mount Wheeler. Some trenching has been done here, revealing the presence of a little copper ore.

At the smelter site, to the east of the Gorge Hotel, schists and highly altered saccharoidal limestones are to be seen striking north and south. The schists have lenticular veins of quartz developed in them, and the same mineral occurs crystallised with ferro-calcite and ilmenite.

The ranges, which have a general north and south alignment, are, in great part, built of quartzite and gossan. On the western side of the range, about 1 mile south of the Hotel, much manganese dioxide is developed in slate, striking north-north-west, but exhibiting a well marked slaty cleavage running north-north-east and dipping east-south-east. Again, about ½ mile south-west of the Hotel, is to be seen a well marked west-north-west crop of black siliceous rock, containing scattered crystals of pyrite and magnetite.

As mentioned under topography, this is one of the best localities in which to note the progress of the reduction of the old Cloncurry peneplain. Not only can the former coextension of the mesas and flat topped ridges be imagined, but the general elevation of the conical hills and hogbacks is noticeably similar. The conical hills further form groups, and are plainly due to the dissection of mesas or ridges.

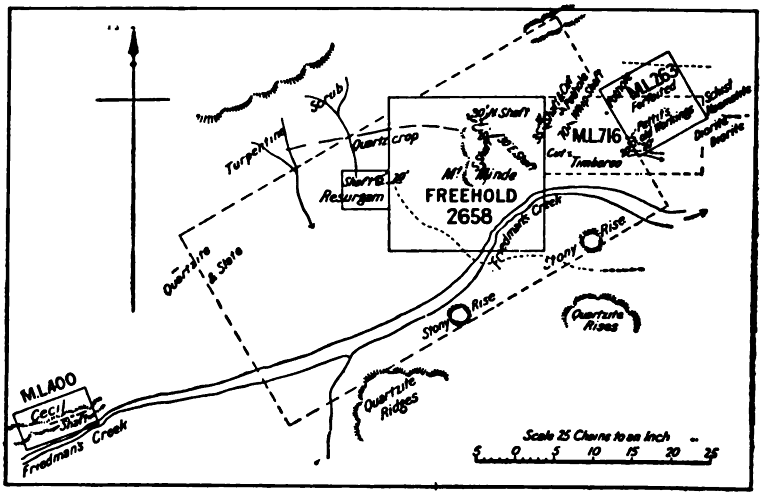
A number of claims on Slaty Creek could not be seen owing to general ignorance as to their exact location.

OUTPUT.

The total output for the years 1903, 1904, 1905, and 1906 is 323 tons of ore of an average tenor of 30% copper.

TIMBEROO GROUP.

The Timberoo group includes holdings in the vicinity of the old Mount Minde Freehold, lying between Slaty Creek and Mount Sheaffe.



Mount Minde (M.F. 2658).

LOCATION, AREA, ETC.

This freehold is situated on Friedman's Creek, a branch of Slaty Creek, 18 miles south-west of Cloncurry. It is 3 miles by road from the Gorge Hotel.

Its area is 40 ac. Deserted at time of visit.

LITERATURE.

(2) Dr. Jack speaks of the Mount Minde in the following terms:—

> The northmost of the copper lodes (*Selection No. IX.*) is situated on the west side of the road, about 20 miles from the township, and within the drainage area of Slaty Creek, a large tributary of the Cloncurry. It is about one mile to the north of Mount Sheaffe, whose position is given on the map. The slate of the country in which the lode occurs strikes WSW. to ENE. Near the lode is a mass of diorite. Its relation to the slate is not very clear, but it is, in all probability, intrusive, and may be suspected to have influenced the production of the copper ore. The principal lode strikes WNW. to ESE. For about twenty yards it stands seven or eight feet above the ground. It has a quartz matrix, with great pockets of green carbonate of copper, red oxide, and "tile ore." A branch lode strikes off it to the south-east. It contains some green carbonate, which I should estimate to contain 40 per cent. of metallic copper, and some red oxide mixed with silica, which I should reckon 30 per cent. ore. From what can be seen at the surface, I should say this mine is capable of turning out a large quantity of payable ore.

(8) Mr. Gibb has published the following analysis (Government Analyst):—

(r) Rejected from ore raised—

Copper = 18·9
Silica = 10·3
Iron protoxide = 45·7
Alumina = 5·3
Lime = tr.
Sulphur = 0·4

80·6

DEVELOPMENT.

The workings include one trench and four shafts, which, it is understood, were put down during 1904 by a tributer (Purvis). The northern shaft, within 4 ch. of the northern boundary of the freehold, was begun 10 ft. north of a crop, and is vertical for 20 ft., and then underlies northwards for 10 ft. The southern shaft, 2½ ch. to the south-east, is 20 ft. deep, and 10 ft. east of it is the eastern shaft, which is 30 ft. deep, and connected with the former by a drive at 10 ft. depth. The western shaft, 20 ft. deep, is near the western boundary. All these workings, having been so long abandoned, are inaccessible.

OUTPUT.

	Aver. 38 %
1904 ...	24 tons (Purvis), shipped, averaging 38 % copper.
1905 ...	79 „ (Allis).
Total ...	103

ORE-BODIES.

Two separate ore-bodies have here been worked, the northern striking east-north-east (and dipping northwards), and the southern east-by-north (and vertical). Contorted but generally vertical lenticularly quartz-veined schists crop on the hillocks to the west, and chloritic schist has been thrown out of the southern workings.

The cap of the northern ore-body, where exposed over a length of 10 ft. in the trench, is barren quartz and dense limonite, up to 4 ft. in thickness, but pinching to 1 ft. at the western end. The country here is epidotic slate, in which are veins of muscovite rock. Nothing can be seen in the shaft, but about ½ ton of ore—limonite with a little cuprite and malachite and some chalcopyrite, probably running 15% copper—has been left in the paddock. A greenish-white hydromica occurs in aggregates, with occasional quartz crystals in the oxidised ore here.

In the southern shaft, a body of cupriferous gossan, 18 in. wide, is cut out, at 10 ft. below the surface, by a head, dipping 45° to the south. The country is stained by malachite, and should carry 2 to 3% copper over a width of 4 ft. beneath the head, which ought therefore to be followed down. The drive is in rich but siliceous oxide and carbonate.

The eastern shaft also exposes 18 in. of ore (10% copper) between fairly well defined walls. Further development should therefore be undertaken here.

The western shaft is on the line of strike of the Resurgam orebody, but only stains of copper have been found in it.

A large vein of quartz crops in the north-western part of the freehold, and if continued would run into the Timberoo workings, but within 10 ch. of them it ends quite abruptly as towards the west. It stands out like a wall, 5 to 20 ft. wide, for at least 5 ch. to the west 10° south of the freehold, and some fairly rich boulders of copper ore there lie scattered over the surface. For the most part, however, the crop is barren, in only one or two places being strongly ferruginous and slightly cupriferous.

Timberoo (M.L. 716).

Mgr., Matheson.

LOCATION, AREA, ETC.

The Timberoo adjoins the Mount Mindo freehold on the north-east.

Its area is 20 ac. This lease has been taken up by the Willcocks Cloncurry Development Syndicate, to include the workings on surrendered leases Nos. 200 (surrounding the freehold) and 263 (lying to the north-east) previously worked by Allis and party.

LITERATURE.

(8) Mr. Gibbs gives the following analyses (Government Analyst):—

Left in reef—		Selected for shipment—	
Copper	= 25·8	Copper	= 47·6
Silica	= 13·9	Silica	= 5·9
Iron protoxide	= 30·3	Iron protoxide ...	= 16·2
Alumina ...	= 6·5	Alumina	= 2·1
Lime	= tr.	Lime	= tr.
Sulphur	= 2·9	Sulphur	= 9·2
	79·4		81·0

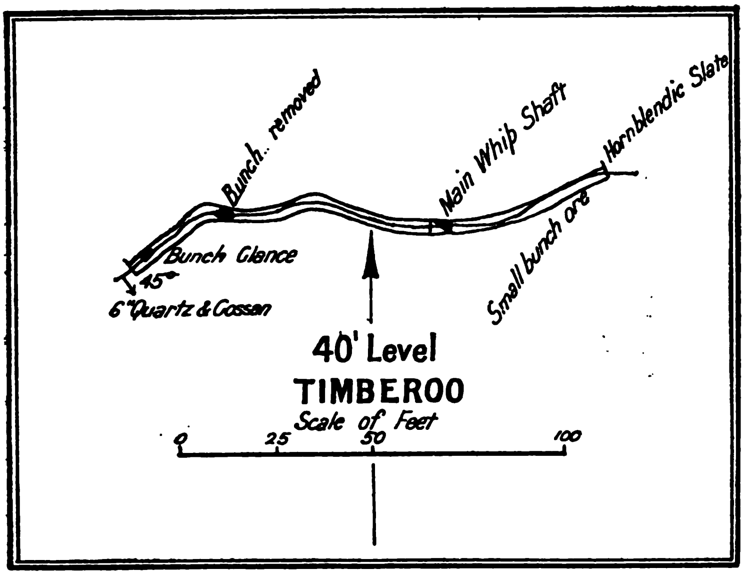
DEVELOPMENT.

The workings comprise two potholes, three opencuts, and five shafts.

One of the potholes lies 1 ch. north 30° west from the main shaft, and the other 2½ ch. north 15° east of the same.

One opencut, 40 ft. long, is at the western shaft; another, 20 ft. long and 8 ft. deep, is 4 ch. south of the main shaft; and the third (continued down as a stope) extends 20 ft. west and 20 ft. east from the main shaft itself.

The western shaft is on the boundary, about 5 ch. from the north-western corner. It is 35 ft. deep, and inaccessible.



The main whip shaft lies 3 ch. to the east. It is 3 ft. 6 in. by 7 ft. in the clear and 54 ft. deep,* further sinking being prevented by influx of water—viz., 1,400 gall. per hour.† On the 45-ft. level crooked drives have been carried 45 ft. eastwards and 65 ft. westwards, and the ground has been stoped out for up to 20 ft. east and from 12 to 20 ft. west of the shaft.‡

Pettit's three old shafts lie 9 ch. east-south-east of the whip shaft. Two are 20 ft. deep and ½ ch. apart; and the third is 25 ft. deep and lies ½ ch. north-east of the first.

The mine had been idle for some time, but three men arrived on the day of my visit to begin work.

OUTPUT.

1904 ...	78 tons	carrying	30%	copper
1905 ...	24 ,,	,,	50%	,,
1906 ...	24 ,,	,,	51%	,,
Total ...	126 ,,			

ORE-BODIES.

There would appear to be at least three parallel lines here, along which ore-bodies have been located at intervals. These lines have a generally east-north-east strike in both the Mount Minde freehold and the Timberoo lease, and may be continuous through the two, though the ore-bodies are lenticular and limited in their horizontal extent, and those in separate workings appear to have no connection.

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* The Warden reported it to be 90 ft. deep in Jan., 1907.

† This increased to 3,000 gall. per hr. at 63 ft. depth.

‡ A winze has also been sunk 13 ft. (16/3/07) at 30 ft. from the shaft in the western drive 45 ft. level.

The occurrence of diorite to the east of the lease is to be noted, and the crops of hæmatite in the same locality are of importance as evidence that the copper deposits are due to regional metamorphism.

The main shaft itself, being timbered, reveals nothing as to the nature of the ore-body.[*]

Since my visit a pump has been installed and sinking resumed, and from the manager's reports it is learnt that at 63 ft. from the surface the ore-body became confused and irregular, that from 67 to 72 ft. there was no defined lode, and that "at 73 ft. from the surface the vein of pyritous ore passed into the hanging-wall side of shaft, dipping too flat to follow economically." Sinking was then in chloritic schist, and levels were to be opened at 100 ft. from the surface. The water raised contained free sulphuric acid as well as copper; but the manager told me later that, in the shaft below the 40-ft. level, there is a fine body of glance, 3 ft. wide, and that the last 12 ft. of sinking produced 27 tons of ore, carrying 50% copper, and 3 tons of seconds, carrying 20%. The drives afford an instructive section. In the eastern drive only one small bunch of ore is visible, and the end is in chloritic slate; but the parallel slickensided partings of a shear-zone have been followed in the western drive to the west-north-west, west, and then south-west—any dip which does exist being to the south. On most of these from 1 to 6 in. of gossan is found, and every now and then a bunch, up to 18 in. wide, of high grade chalcocite. Sometimes the parting dies out, and the gossan is then found to continue on an adjacent one. The whole is promising for permanence in depth, but no considerable body of ore has yet been proved. Owing to the drive having been half-filled with mullock, the floor cannot be seen.[†] The ore at grass ready for bagging is tile ore, chalcocite-chalcopyrite, chalcocite-bornite, and pyrite; and there is about 1 ton of rich oxide bagged. This is the only mine in the district at which bornite was noticed. Another unique occurrence is that of crystal aggregates of a form of light-green hydro-mica in the gossan. The crystals are sometimes ¼ in. in diameter, and the laminæ, which are easily separated, are slightly elastic.

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[*] The Warden reported 3 ft. glance at 35-ft. level (2/2/05), and later that 27 tons of 50 % ore had been obtained in sinking from 29 ft. to 54 ft. (6/1/06).

[†] The manager, in his report (5 May, 1906), refers to "the solid ore-body rising to the bottom of the level, thence merging into gossan, containing nodules of copper glance," and further states that in driving from 56 ft. to 62 ft. 1 ton of 45% ore was obtained, while 8 tons of 50% ore were produced in driving from 30 ft. to 65 ft. Underhand stoping has been carried out below the 45-ft. level—6 tons of 50% ore being culled for the first fortnight. In the winze below the 45-ft. level, at 6 ft. depth, the "pyritous ore-body" was 3 ft. wide, and assayed 40% copper; at 9 ft. depth, the ore-body, 4 ft. 6 in. wide, bulked 42% copper, and 10 tons of 50% ore had been raised, while 10 tons of high grade ore were obtained in sinking the last 4 ft.

The western shaft and opencut seem to be on a separate lens to either the Mount Minde or Timberoo main shafts. The shaft was opened on 15 in. cupriferous gossan running vertically east 10° south, and pinching in the western end of the opencut to 6 in. The country rock is horneblendic schist and slate, that on the tip containing quite 5% of white, sintery lime. There is 10 tons of ore at grass, probably containing 10% copper (as malachite).

Some very fair ore has been raised from the southern opencut, and the 3 tons of seconds at grass—malachite and tile ore in limonite—should yield 20% copper.

The pothole to the north-west of the main shaft exposes a vein of quartz dipping 80° to the south 30° west, in chloritic schist. The quartz is mostly barren, but some bunches of malachite and tile ore in limonite have been broken into.

In the eastern pothole a vein, 2 to 6 in. thick, of gossan, with some tile ore and carbonate, has been found.

Pettit's workings are on small lenticular bodies in quartz, and, from surface indications, are not worth much attention.

The south-western shaft is on a blow of quartz striking east-north-east and vertical or underlying very steeply to the south. The quartz is 2 ft. 6 in. wide at the surface, and increases to 4 ft. in width within 5 ft. of the surface. Only the faintest stains of copper can be seen.

Pettit's south-eastern shaft was sunk in altered speckled rock 5 ft. south of the same crop, where it is slightly cupriferous. Several large blocks of calcite were raised, the mineral presumably being associated with the quartz.

In Pettit's northern shaft a lens of quartz 10 ft. long strikes east-north-east, and at the surface is 12 in. wide, but pinches downwards. Some dense limonite, with a small percentage of malachite, must have come from the lower part of the shaft, and it is understood that some ore has been shipped from here.

Resurgam (M.L. 399).

Mgr., Pettit.

LOCATION, AREA, ETC.

The Resurgam adjoins the Mount Minde Freehold on the west. Its area is 3 ac. This appears to be the Duffer claim.

LITERATURE.

(8) Mr. Gibb gives the following analyses (Government Analyst) :—

(r) Rejected (three-fourths) from ore raised—

Copper	= 12·6
Silica	= 51·3
Iron protoxide ...	= 15·3
Alumina	= 7·0
Lime	= 9·2
Sulphur	= 0·5
	95·9

(s) Selected for shipment—

Copper	= 31·5
Silica	= 18·4
Iron protoxide ...	= 20·4
Alumina	= 1·5
Lime	= tr.
	71·8

DEVELOPMENT.

Much trenching has been done, for no result, to the west of the main workings, where there are two shafts: one, 45 ft. deep, lying 2 ch. south-west of the north-eastern corner, reaching water-level; and another 33 ft. deep, 25 ft. west-south-west of the above. The ground between the two shafts has been stoped out. There was one man on the ground at the time of my visit, but little work has been done during the last twelve months.

OUTPUT.

		100 tons from 45 ft. shaft, aver. 35 to 36% copper (*fide* Mr. Pettit).
1904	...	51 tons (Duffer)
Total		151 tons.

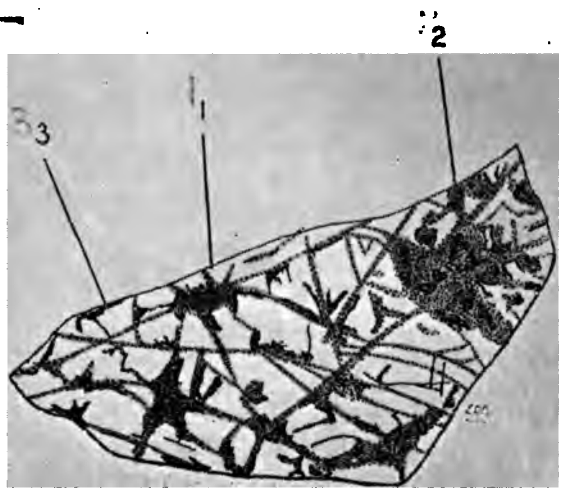


FIG. 20 (TWICE NATURAL SIZE).—ENRICHED ORE, RESURGAM.

1. Chalcopyrite *3. Chalcocite.*
2. Limonite

ORE-BODIES.

The eastern and southern shafts are on a formation, running east-north-east in highly altered chloritic slates. The former was sunk on a rich shoot, 4 ft. wide, the copper ore being in layers 2 ft. thick separated by sinter (locally considered a very good sign for the finding of rich ore), and ill-defined from the country. It is asserted that 100 tons of 35% ore have been raised from this shaft, but very little ore, except some patches of leached chalcopyrite, can now be seen. The ore has been broken down for 10 ft. east of the shaft, where dense brown siliceous limonite occurs at the surface.

Half-way between the two shafts a tongue of country comes in, and a branch of the ore-body running off to the west has been stoped out for 15 ft.

In the southern shaft lumps of glance have been found irregularly scattered through a limy formation over a width of 6 ft. north of the shaft, but the present faces are barren. One specimen obtained shows plainly the alteration of chalcopyrite into limonite and glance. The chalcopyrite appears to have cracked in all directions, allowing of the formation of thin films of limonite, and subsequently the isolated particles of chalcopyrite have been replaced by chalcocite to a greater or less extent. (See Fig. 20.)

Cecil (M.L. 400)

Mgr., Lobeston.

LOCATION, AREA, ETC.

The Cecil is ½ mile west-south-west of the Mount Minde.

Its area is 5 ac. Not visited.

One shaft is shown on surveyor's plan.

Marguerite (M.C. 151).

Mgr., Grenier.

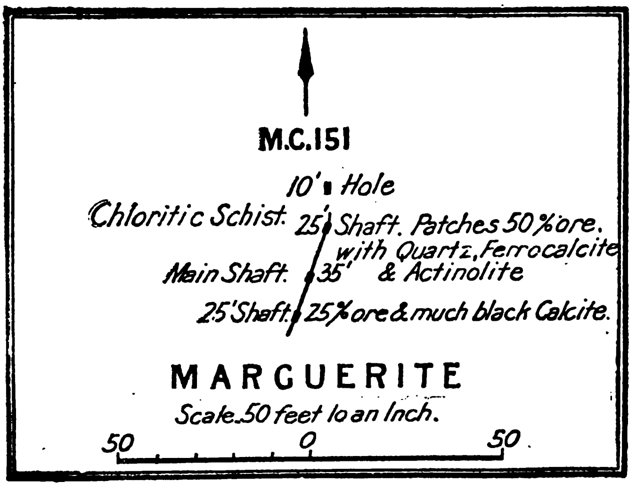
LOCATION, AREA, ETC.

The Marguerite lies about 1 mile south of the Mount Minde freehold.

Its area is 200 ft. × 350 ft. Apparently abandoned.

DEVELOPMENT.

The main workings, at the northern end, comprise three shafts and a pothole, the last being at the extreme north and only 10 ft. deep. A shaft, 10 ft. to the south of the pothole, is 25 ft. deep (inaccessible); 20 ft. beyond is the main shaft, 35 ft. deep; and another 25 ft. deep, and inaccessible, lies 10 ft. further south. To the south outside of the claim and 5 ch. distant is a trench, and 2½ ch. beyond it is a hole, 5 ft. deep, 1 ch. south-south-east of which is a 10 ft. shaft.


M.C.151
10' Hole
Chloritic Schist
25' Shaft. Patches 50% ore. with Quartz, Ferrocalcite & Actinolite
Main Shaft 35'
25' Shaft 25% ore & much black Calcite.
MARGUERITE
Scale 50 feet to an Inch.
50
0
50

OUTPUT.

1904	...	3½ tons (Grenier), shipped
06	...	8½ ,, (,,), ,,
Total		12 ,, ,,

ORE-BODIES.

There are here three detached outcrops, which, though lying on a north and south line, are parallel and probably on distinct zones, striking north 5° east, and dipping 10 in 1 h. to the west.

The crop at the main shaft consists of bunches of cellular gossan, 6 in. wide, but at the bottom there is a body of limonite, 15 in. wide at the southern end and 6 in. wide at the northern, with walls not slickensided but well defined. This is most promising, and sinking should be continued.

The northern shaft is in chloritic schist country, carrying bunches of 40 to 50% ore associated with quartz and ferro-calcite, both of which are pierced by long thin needles of black tourmaline.

In the southern shaft much black calcite was met, besides which some 25% ore is reported to have been shipped.

The 5 ft. hole to the south exposes 2 ft. 6 in. of cellular bluish gossan—almost certainly leached copper ore—dipping 70° to the west-north-west in laminated country. The pothole to the south of this proved only schists, being too far to the east, but the trench to the north shows quartz strongly stained by malachite.

This claim is on the line of strike of the Brilliant crop, the only other striking north and south in the Slaty Creek catchment.

GEOLOGY.

The north and south strike and the inter-crystallisation of the quartz and calcite are indicative of the ore bodies occurring in originally calcareous sedimentary beds, now tilted into a vertical position. The occurrence of tourmaline in the quartz and calcite is evidence that during the metamorphism pneumatolysis took place owing to relief of pressure. The copper ores have therefore most likely been derived in this case from deep-seated igneous rocks in process of cooling.

Ida (M.C. 179).

Mgr., Dannes.

LOCATION, AREA, ETC.

The Ida is about ½ mile west-by-south from the Two Mile well.

Its area is 200 × 350 ft.—one man's ground.

One shaft, 20 ft. deep, is in process of being sunk.

OUTPUT.

3 tons shipped, carrying 38 % (*fide* Mr. Dannes).

ORE-BODY.

The shaft was sunk on calcite, ferro-calcite, and limonite, with occasional small bunches of chalcopyrite, especially on the eastern side of the shaft. The ore-body, which in the shaft is 2 ft. thick in one place, appears to pinch out in the sump. It strikes east 10° north, dipping 80° to the south. The country rock is clay schist, the footwall being much indurated.

Unnamed (M.C. ?).

Mgr., McEvoy.

LOCATION, ETC.

This abandoned claim is about ¼ mile west-south-west of the Two Mile well on the Gorge-Duck Creek road, and about 2 miles east of the Mount Minde freehold.

Only trenches have been opened here.

ORE-BODIES.

The ore-bodies here are of little economic import, but the mineralogical associations are most interesting. Chalcopyrite has been found in small quantities with stains of malachite, and set in the former are crystals of quartz pierced by radiating needles of tourmaline. Mr. McEvoy here found one small patch—in all about 4 lb. in weight—of bismutite, a specimen of which given me is light-green in colour, is coated with red clayey gossan, and encloses crystals of quartz.

Brilliant (M.C. 159).

Mgr., Savage.

LOCATION, AREA, ETC.

The Brilliant lies about 2 miles south of the Mount Minde freehold, and 1½ mile north-west of the Two Mile well.

The area is 400 ft. × 350 ft. Apparently abandoned.

DEVELOPMENT.

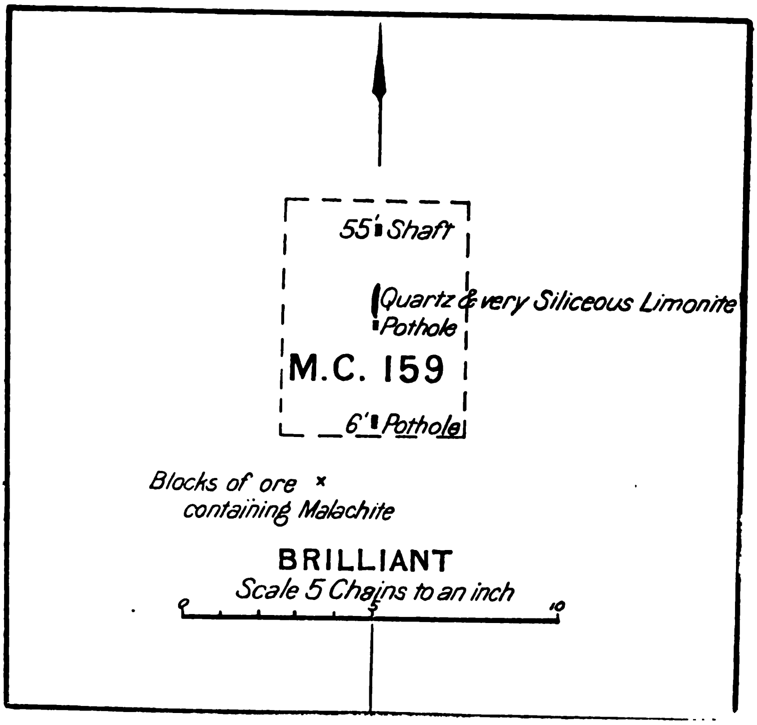
The main shaft, at the northern end, is 55 ft. deep. At the 45-ft. level a drive runs 20 ft. north, and a monkey shaft at the end, 10 ft. deep, has been filled in. The only other workings are two potholes 2½ and 5 ch. to the south.

OUTPUT.

40 tons shipped, carrying 26 to 32% (*fide* Mr. McEvoy).

ORE-BODIES.

As mentioned, this and the Marguerite are the only north- and south-striking ore-bodies in the Slaty Creek district, and are perhaps on the one line, though there are no intermediate workings. The country rock is chloritic schist.


55' Shaft
Quartz & very Siliceous Limonite
Pothole
M.C. 159
6' Pothole
Blocks of ore containing Malachite
BRILLIANT
Scale 5 Chains to an inch
0
5
10

The main outcrop of quartz and siliceous limonite is over a chain south of the shaft, and no work has been done on it, though two bags of medium-grade ore were got from the pothole at the southern end. The southern pothole exposes cellular gossan 18 in. wide and dipping 70° to the west, barren, but well worth prospecting by sinking.

The shaft was sunk in quartz and cellular gossan (göthite and limonite), the latter containing crystallised malachite and in the denser portions chalcopyrite, but no quartz; the latter, which occurs chiefly on the southern side of the shaft, being barren-looking, but its cavities lined with crystals and stained by gossan. Along the drive the body of gossan and quartz is 4 ft. wide, but in the end it has pinched to 2 ft. 6 in. The walls here are well defined, but not slickensided. A shoot of ore, rich in copper, pitched from the shaft, at 10 ft. depth, to the end of the northern drive, its inclination being thus 1½ in 1. The whole of the tip, approximately 100 tons, is rich in tile ore and malachite, and should average 10% copper, while 10 tons of 20% ore could easily be picked out. Only two tons of firsts are paddocked, the remnant of 40 tons lately shipped.

The character of the walls, which are in places 5 ft. apart, is not unpromising for permanence in depth, and the nature of the ore is strongly indicative of there being much richer copper ore below the present workings.

Unknown (M.L. ?).

Mgr., Allis.

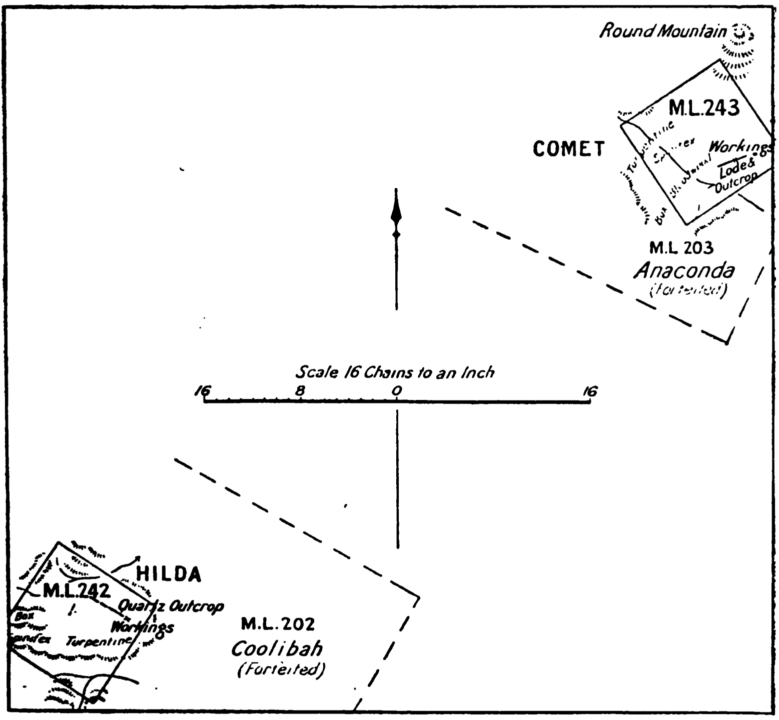
LOCATION, AREA, ETC.

This lies ½ mile south-west of the Gorge Hotel, which is 16½ miles south-west-by-south of Cloncurry.

Several potholes have been opened at some time in the past.

ORE-BODIES.

The potholes lie on an east and west line, and, in the easternmost, the ore body is seen to dip 80° to the south. The eastern cut is in a bunch of siliceous copper-bearing iron ore, 10 ft. in length and 2 ft. 6 in. in total width. Of this the half on the hanging-wall is chiefly flaky hæmatite (specularite) and limonite, but the hanging-wall half of the lode may run 20% copper.



HILDA GROUP.

The Hilda Group takes in the few scattered holdings on the southern branch of Slaty Creek, followed by the Boulia road.

Comet (M.L. 243).

Mgr., Matheson.

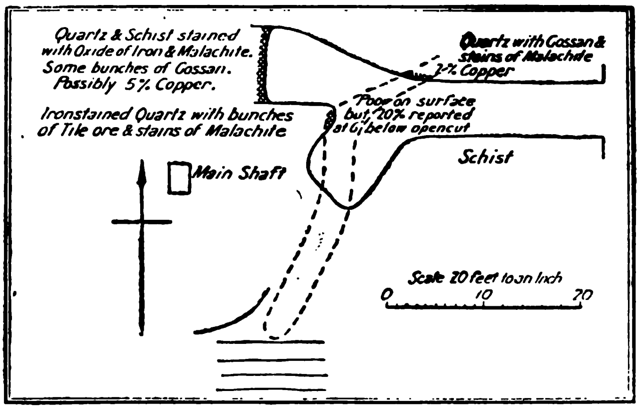
LOCATION, AREA, ETC.

The Comet is 20 miles south-west-by-south of Cloncurry, and about ½ mile west of the Boulia road, 3 miles from the Gorge Hotel.

Its area is 10 ac. This is part of a forfeited lease known as the Anaconda. It is now the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

The main excavation is an open cut, 6 to 8 ft. wide, 2½ ch. west of the eastern corner of the lease; it runs 35 ft. west and 7 ft. from the end there is a branch, 10 ft. long, to the south-west.


Quartz & Schist stained with Oxide of Iron & Malachite. Some bunches of Gossan. Possibly 5% Copper.
Ironstained Quartz with bunches of Tile ore & stains of Malachite
Main Shaft
Quartz with Gossan & stains of Malachite 2% Copper
Poor on surface but 20% reported at 6' below opencut
Schist
Scale 20 feet to an inch
0
10
20

SKETCH PLAN OF WORKINGS, COMET.

A vertical shaft was being sunk in October last, 25 ft. west-south-west of the central tongue of the cut; and from it it was proposed to drive back to the rich shoot of ore.*

ORE-BODIES.

The ore is found in a belt of schist, striking about west-south-west, which can be followed to the western boundary of the lease from the open cut, a trench at 1½ ch. distance exposing 18 in. iron-stained quartz with some malachite. In the western end of the opencut there is 8 ft. width of schist and quartz, stained by iron oxides and malachite, and carrying some bunches of gossan. Over the whole width it should average at least 5% copper. Another body of richer ore comes in from the north-east, and has been followed in the south-western branch of the cut. On the northern side of the cut it is 2 ft. wide, and consists of quartz with gossan and stains of malachite, the copper content perhaps reaching 2%; but in the central tongue of the cut can be seen iron-stained quartz, with bunches of tile-ore and stains of malachite, somewhat richer. This body has been trenched to 6 ft. below the floor of the opencut and filled in, but Mr. Matheson informed me that, though so poor on the surface, a sample from the bottom of the trench yielded 20% copper.[*]

---

* From the manager's reports it is learnt that a crosscut 12 ft. long was put across it at the 50 ft. level, a drive 10 ft. wide being then carried east 22 ft. (30th March, 1907). The shaft has also been sunk a total depth of 58 ft. (27 May, 1907).

There are 100 tons of ore from the open-cut at grass. It consists of very siliceous schist, all carbonate-stained and containing bunches of tile ore, fragments of quartz being often cemented by limonite, in which some of the original chalcopyrite can be distinguished. It is expected to yield between 10 and 15% copper.

Nothing of promise is to be seen here. The quartz has presumably segregated, during the metamorphism of the country into chloritic schist, especially along crush-zones which have later allowed circulation of cupriferous solutions. It is possible that some hundreds of tons of comparatively low-grade and siliceous ore may be broken down here, but there is no likelihood of payable ores being found to descend.

Hilda (M.L. 242).

Mgr., Matheson.

LOCATION, AREA, ETC.

The Hilda is about 1 mile west of the Comet. The country is low rolling ridgy, and it is covered with stunted box and gum and with scrubby heath.

Its area is 10 ac. This lease is the property of the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

There is only one shaft on this lease. It was sunk 27 ft. by Mr. Allis, the former holder, and has been continued 3 ft. by the syndicate. It is vertical for 20 ft., and then underlies 3 in 1 to the northwards.

The manager's reports to the end of March, 1907, state that the shaft has since been sunk a total of 64 ft., and levels opened east and west at the 60-ft. level.

---

[*] Since my visit the shaft has reached the hanging-wall of the formation at 46 ft., and at 58 ft. was in iron oxides, quartz, and hard copper carbonates. The ore-body has been proved to be 10 ft. wide in the crosscut on the 50 ft. level, 10 tons of 20% ore having been produced, the average contents of the whole being therefore 5%, though the first 4 ft. averaged 25%. In the eastern drive the face at 6 ft. distance from the crosscut assayed 9% over a width of 10 ft.; but at 12 ft. the 5 ft. on the hanging-wall assays 20%, the footwall portion being very siliceous and low in copper; at 18 ft. half the product was rejected, leaving 18% ore, and the face at 22ft. is unchanged.

Ore-bodies.

The outcrop strikes west 30° north. For 1 ch. north-west of the shaft quartz, with much lime and some gossan, is to be seen, when there is a break for ½ ch., and then another crop for a similar distance, beyond which there are only a few small lenses of quartz on the line of strike. For 2 ch. to the south-east of the shaft limestone, quartz, and quartz-bearing schist crop on the line, giving little indication of the rich ore met in the shaft. The country north of the shaft shows abundant epidote, and, though resembling an altered volcanic, is apparently a metamorphosed sedimentary.

In the shaft the country is indurated near the lode, but the walls are not slickensided, though well defined, and there is 2 to 3 in. of earthy lime, with inclusions, on the footwall from top to bottom of the shaft. Much quartz was found with the limonite for about 15 ft. from the surface. At the shaft bottom the ore-body—mostly dense limonite with disseminated malachite and cores of tesselated chalcopyrite and chalcocite, and of almost pure chalcocite—gossany in parts, is 3 ft. wide,[*] and from the last 3 ft. of sinking 8 tons of 15% ore were paddocked.[†] The gossany parts of the ore contain a considerable amount of manganese dioxide, and a few drusy calcite crystals were noticed. The ore in the lower part of the shaft is noticeably free from quartz, and will therefore be valuable in smelting mixtures, even though yet comparatively low in copper.

Mascotte (M.C. 319).

Mgr., Corney.

Location, Area, Etc.

The Mascotte is about 1 mile south-east of the Comet.

Its area is 600 ft. × 350 ft.

Development.

The workings comprise one shaft, 10 ft. deep, in the centre of a trench, 20 ft. long and 3 ft. deep; Allis's old trench, 10 ft. long and 5 ft. deep, 1½ ch. west of the shaft; and a pothole, 3 ch. east of the shaft.

Output.

1898 ... 3½ tons shipped, carrying 68% copper (*fide* Mr. Corney).

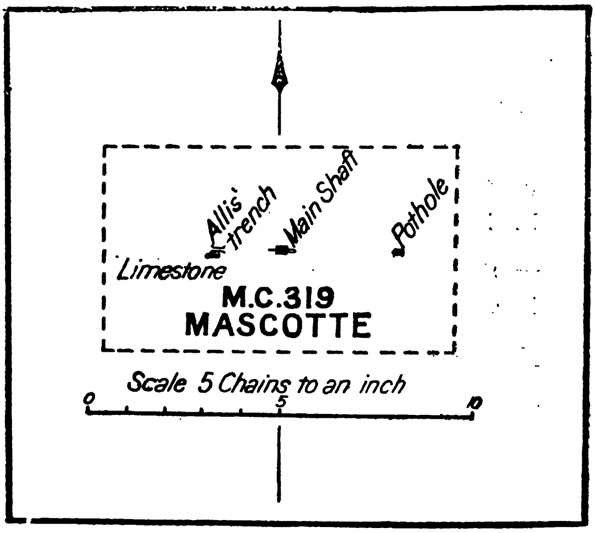
Ore-body.

The strike of the ore-body is east 15° north. It makes little crop at the surface, there being only one exposure of cupriferous gossan betwen the old trenches. The country is schist rather indurated and jointed near the ore-body.

---

[*] The manager's reports tell that at 36 ft. and 43 ft. depth the lode is still 2 ft. 6 in. wide, at the latter point assaying 14% copper, but, at 58 ft. depth, there is only 12 in. siliceous ore. The drives on the 60 ft. level were begun in soft calcareous formation, 2 ft. wide, with bunches of ore, but at 6 ft. from the shaft it appears to have been leached of copper.

[†] The total ore raised in sinking the shaft to 58 ft. was 40 to 50 tons, averaging 15% copper.



The trench at the main shaft exposes up to 3 ft. width of ferruginous calcite, containing patches of quartz and chalcocite; but in the shaft the ore began to improve at 5 ft. below the surface, and in the bottom is exposed very good tile-ore (much resembling limonite) and malachite, with some chalcopyrite altering into chalcocite. The firsts paddocked amount to 2 tons, and are estimated to contain 40% copper, while the seconds, ½ ton, should yield 25%.

Allis's old trench, which is 5 ft. north of a small crop of limestone, and from which some splendid cuprite encrusted with malachite and embedded in powdery gossan has been taken, proves the ore-body exposed by it to pinch out within 10 ft.

In the eastern pothole can be seen iron-stained schist and gossan with tesselated limonite—very low in copper. This ore should be sunk on, as it is likely to improve beneath the surface.

Hermit (M.C. 339).

Mgr., Corney.

Location, Area, Etc.

The Hermit lies about 1½ mile east of the Mascotte.

Its area is 600 × 350 ft. It was not visited.

Output.

1906 ... 6 tons shipped (Press).

Ore-body.

The ore-body is said to be similar to that of the Mascotte.

CORELLA RIVER.

The mines are scattered over an area extending 20 miles from north to south and 10 miles from east to west, being located chiefly on western and southern affluents of the Corella River. Most of them were under exemption, and, being deserted, no attempt was made to locate and examine them.

The country is mostly mountainous, is badly watered, is poorly timbered, and is highly uninviting for any purpose except mining.

A dray road has now been opened from Duck Creek to the more important mines, which may also be reached by following up the Corella River from the Argylla road, the distance from Cloncurry to the Springs Camp, a well known centre, being approximately 50 miles by either route, though by an air-line west-south-west it is only 34½ miles.

EAST CORELLA GROUP.

This group is of little import, including only the Wakeful besides the claim here noticed.

Lady Franklin (Extd. M.C. 122).

Mgr., Hinds.

LOCATION, ETC.

The Lady Franklin is situated on Franks Creek, 14 m. west of the Gorge Hotel. The claim could not be visited.

DEVELOPMENT.

No. 1 shaft is 40 ft. deep (December, 1906), and No. 2 shaft is 18 ft. deep (January, 1907).

OUTPUT.

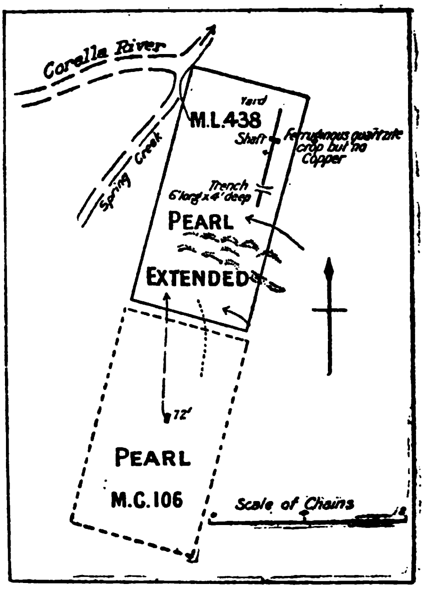
1906	20	tons raised (reported)
	$4\frac{19}{20}$	,, shipped.

ORE-BODIES.

Early in 1906 it was reported that No. 1 shaft was "on 7 ft. of silver-grey ore," and that No. 2 shaft was on blue-grey ore. At that time 15 tons had been raised for despatch.

PEARL GROUP.

The group comprises the eastern leases on the Corella River, including the Imperial and Fairy, not mentioned below.



Pearl Fxtd. (M.L. 438).

Mgr., Lawes.

LOCATION AND AREA.

The Pearl Extended is located on the eastern side of the junction of Jimmy's Springs Creek and the Corella river, 3 miles north-north-east of the Springs Camp.

Its area is 5 ac.

DEVELOPMENT.

The workings comprise a trench, 6 ft. long and 4 ft. deep, near the middle of the eastern side, and a shaft, 18 ft. deep, 2 ch. to the north, sinking having been stopped by water.

OUTPUT.

1906 ...	... 1 ton at grass, carrying 5 % copper.

ORE-BODIES.

To the north of the shaft barren ferruginous quartz outcrops, striking north by east. The shaft has passed through a body of gossan 18 in. wide dipping 3 in 1 to the westwards, and well worth following on the underlie.

The trench exposes a cupriferous gossany formation, 12 in. wide, on the line of strike of the gossan cut in the shaft, and under a gossany formation 4 ft. wide dipping west-by-north. About 1 ton of 5% ore is at grass here.

Pearl (M.C. 106).

Mgr., Lawes.

LOCATION AND AREA.

The Pearl adjoins the Pearl Extended on the south.

Its area is 600 ft. × 350 ft.

DEVELOPMENT.

A shaft, underlying 3 in 1, has been sunk in the centre of the claim to a depth of 72 ft., but was not accessible to me below the 40 ft. level, where there is a drive for 12 ft. to the north. A stope extends 10 ft. southwards from the shaft to 54 ft. below the surface. A second shaft, 15 ft. deep, lies in the south-western corner of the lease.

OUTPUT.

		$30\frac{17}{20}$	tons shipped, carrying from 32 to 37 % copper (*fide* Mr. Lawes)
1905	...	14	,, ,, (by Lawes)
		$45\frac{18}{20}$	,, ,, ,,
Total	...	50	,, ,,

ORE-BODIES.

Little outcrop can now be seen at the shaft, but ore from near the surface shown me consists of chalcocite, limonite, and pyrite. The copper ore occurs as gossany bunches and leaders in crushed kaolinised schist. At 10 ft. below the surface there is 2 ft. 6 in. width of carbonate-bearing gossan. The schist is barren in the shaft between the 40 ft. level and water level (at 50 ft. depth) where some chalcopyrite is said to have been found, while glance, coated with amorphous secondary sulphide, was shown me from the shaft bottom. The southern drive at the 54 ft. level is said to be in oxidised ore 2 to 4 ft. wide, and 7 tons of pay ore were obtained from the first 7 ft. of driving. The whole formation underlies 3 in 1 to the west 12° south. It has been proved to be cupriferous only over a length of 20 ft., and it appears to be a distinct ore-body from that being worked on the Pearl Extended.

A second parallel outcrop in the south-western corner of the lease was not inspected.

Brydon's (M.L. 672).

Mgr., McCallum.

LOCATION, ETC.

Brydon's lies 1 mile north of the Pearl and 4 miles north-by-east of the Springs Camp.

Its area is 40 ac. The ground was deserted when visited in December.

DEVELOPMENT.

The main shaft is 20 ft. deep. Lidster's shaft, 20 ft. to the south-west, is 15 ft. deep and has a stope running 6 ft. to the east. Besides these there are numerous other potholes on the lease. No work has been done here lately.

OUTPUT.

1904	...	8	tons	shipped,	carrying	20%	copper.
,,	...	4	,,	,,	,,	25%	,,
1906	...	$4\frac{17}{20}$	,,	,,			
Total	...	$16\frac{17}{20}$	,,	,,			

ORE-BODIES.

The main shaft is in an irregular gossany formation, chiefly silicified country (sedimentary), carrying bunches of carbonates. At the eastern side of the shaft the country is stained over a width of 5 ft. adjacent to a 3 in. band of gossan, and at the shaft bottom over a width of 12 ft., but is not promising. The whole tip from this shaft would probably yield 2% copper.

Lidster's shaft is on a bunch of limonite, replacing chloritic schist and stained by malachite. Lidster shipped 4 tons of 25% ore from here, and there are now 5 tons seconds at grass.

Spring Peaks (M.L. 562).

Mgr., Allis.

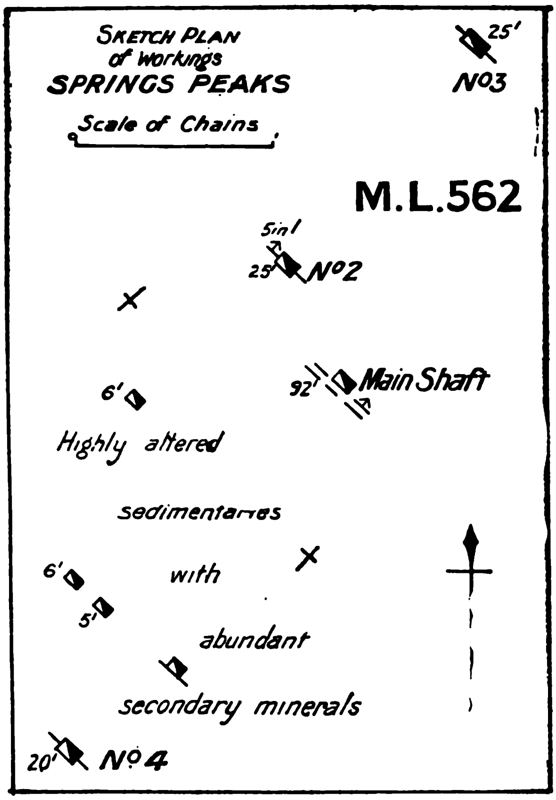
LOCATION, ETC.

The Springs Peaks lease is located on the ridge-top east of Jimmy's Springs Creek, and 34 miles west-south-west of Cloncurry. The lease is ½ mile east-south-east of the Springs Camp on the Cloncurry road, and the brace of the main shaft is 150 ft. above the camp. The lease is in the midst of a worn-down mountain range being surrounded by rounded hills and ridges of approximately the same elevation. These hills are bare of timber, except for a few scattered mountain gum, there being little soil and that of a poor quality.

Its area is 20 ac. Prior to my visit it had been under option to the West Cloncurry Copper, Limited, but some dispute had caused the stoppage of all work in November last.

DEVELOPMENT.

The main shaft near the centre of the lease is 92 ft. deep. No. 2 shaft, 40 ft. to the north-north west of the main shaft, is 25 ft. deep and inaccessible. No. 3 shaft, 2 ch. to the north-north-east of the main shaft, is 25 ft. deep and also inaccessible. No. 4 shaft, 20 ft. deep and inaccessible, is 2 ch. to the south-west of the main shaft. Besides the shafts, there are 4 potholes, 5 to 6 ft. deep, one of them 1 ch. west of the main shaft and the three others on a north-west line 1½ ch. south-west of the same.



ORE-BODIES.

The Springs Peaks is in a region of highly altered sedimentary rocks, which, at the camp, contain much epidote, but the bedding planes can be distinguished, the strike being north 33° east. The slates on the lease are also highly altered, and many secondary crystalline minerals have been developed both at the main shaft and near the potholes to the south-west. At the latter place felspar occurs in distinct crystals, together with much hypersthene altering to a bronzed serpentine, a little opaque white allotriomorphic quartz, greenish-yellow granular epidote, and occasional grains of hæmatite. Chalcopyrite is found in the finer grained parts apparently replacing hypersthene, but chrysocolla veins are plentiful in the most coarsely crystalline rock.

Four separate lines outcrop on this lease, within a distance of 4 ch., but none of them can be traced for any distance along the surface. The main shaft was put down with the idea of proving these at a depth, and at 60 ft. below the surface struck a fifth formation striking east 40° south and dipping north-eastwards, within a few degrees of vertical. Its thickness is generally less than 12 in. and it comprises chiefly ferruginous, crushed, broken, and powdered country (highly altered crystalline sedimentary). The walls are not slickensided, and the formation seems to be only along a large joint. At 60 ft. depth some bunches of malachite-stained chalcocite, replacing chalcopyrite were met, and several veins of chalcopyrite were cut at 70 ft. depth, one 6 in. wide there branching off the main formation and dipping into the northern side of the shaft. In the lower part of the shaft only occasional splashes and impregnations of chalcopyrite are found, and the seam contracts to 3 in. width, but is again opening out in the bottom, and further bunches of ore may therefore be obtained. There are at grass 3½ tons of ore consisting of chalcopyrite and chalcocite, the former having everywhere a thin coat of secondary sulphide on cracks, besides which there are bunches of the same mineral. The paddock is therefore expected to assay between 30 and 35% copper.

No. 2 shaft was opened on an outcrop of gossan, 2 ft. wide, with ill-defined walls; it is reported to have pinched in the bottom, and can be traced for only 10 ft. south-east of the shaft and 20 ft. to the north-west. It strikes south-east and north-west across the stratification of the country rock, and its dip is 5 in 1 to the north-east. There is about 1 ton of gossan, carrying 5% copper (as silicate), paddocked here, but the whole tip carries chrysocolla and will probably yield 5% copper.

No. 3 shaft exposes a north-west running formation of kaolinised slate carrying malachite, chrysocolla, and tile ore, but without sign of walls, the mineralisation being presumably along a cross joint. The 2 tons of firsts at grass are expected to yield over 30% copper.

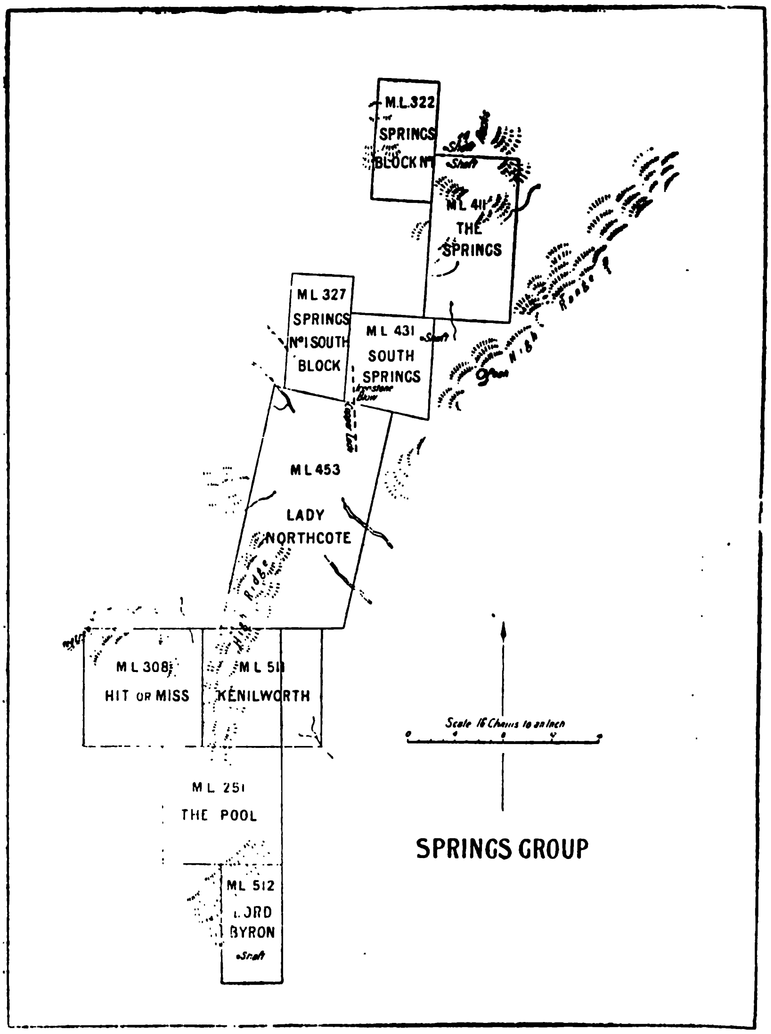
The pothole to the west of the main shaft shows only copper-stained altered slates.

The southernmost of the three holes to the south-west of the main shaft is alongside a 9 in. vertical band of gossany kaolin, the country for several feet to the south-west of which is stained on joints by blue chrysocolla. There is here, as already mentioned, a great development of secondary crystalline silicates. The central hole is in ferruginous kaolinised country with some gossan, but shows no definite lode, though the faces should average 2% copper. The northernmost hole is also in cupriferous and iron-stained country; but 2 tons of cupriferous gossan were obtained here. The 3 tons of rich ore bagged alongside the hole has been "gouged" from different crops all over the lease.

No. 4 shaft is in stained country, adjacent to a north-west striking bunch of ore, 12 in. wide, which has been taken out over a length of 10 ft. There are 3 tons of firsts bagged at the brace, and 4 tons of cupriferous gossan, carrying 10% copper, have been paddocked.

SPRINGS GROUP.

The group includes, besides those described below, the following leases:—Hit or Miss, Pool, Springs Block No. 1, Springs No. 1 South, Springs South, Lady Northcote, Kenilworth, and Ivanhoe No. 1 South.



None of them was visited, as they had been deserted at the end of the year.

Springs (M.L. 411).

Mgr., Entriken.

LOCATION, ETC.

The Springs lies about 1 mile north-west of the camp of the same name.

Its area is 10 ac.

DEVELOPMENT.

A shaft had been sunk 45 ft. in January, 1905.

OUTPUT.

1905	...	25 tons ore shipped.

ORE-BODY.

Lode runs nearly north and south and averages over 6 ft. in width. "It is grey-ore* and of first class quality." "An almost solid body of grey-ore* shows across the width of the shaft at that (45 ft.)

Ivanhoe (M.L.).

Mgr., Hare.

LOCATION, ETC.

The Ivanhoe lies south of the Springs lease.

DEVELOPMENT.

There are a cut, 15 ft. long and 6 ft. deep; a trench, 30 ft. long and 3 ft. deep, on the eastern side of the hill; and a shaft, 10 ft. deep, west of the trench.

OUTPUT.

1904	...	4 tons shipped
		8 ,, seconds at grass
1905	...	15 ,, at grass, low grade.

ORE-BODY.

A formation, 20 ft. wide, at the cut, "Can be traced for a considerable distance." "A large outcrop of medium grade on the same line of outcrop as the Springs."

LADY GROUP.

The Lady Group, which includes the Ralston Leases and a few others, comprises the Lady Ethleen, Lady Nicotine, Lady Jenny, Lady Emily, Lady Amy South, Lady Amy, Lady Amy North, Morning Star,

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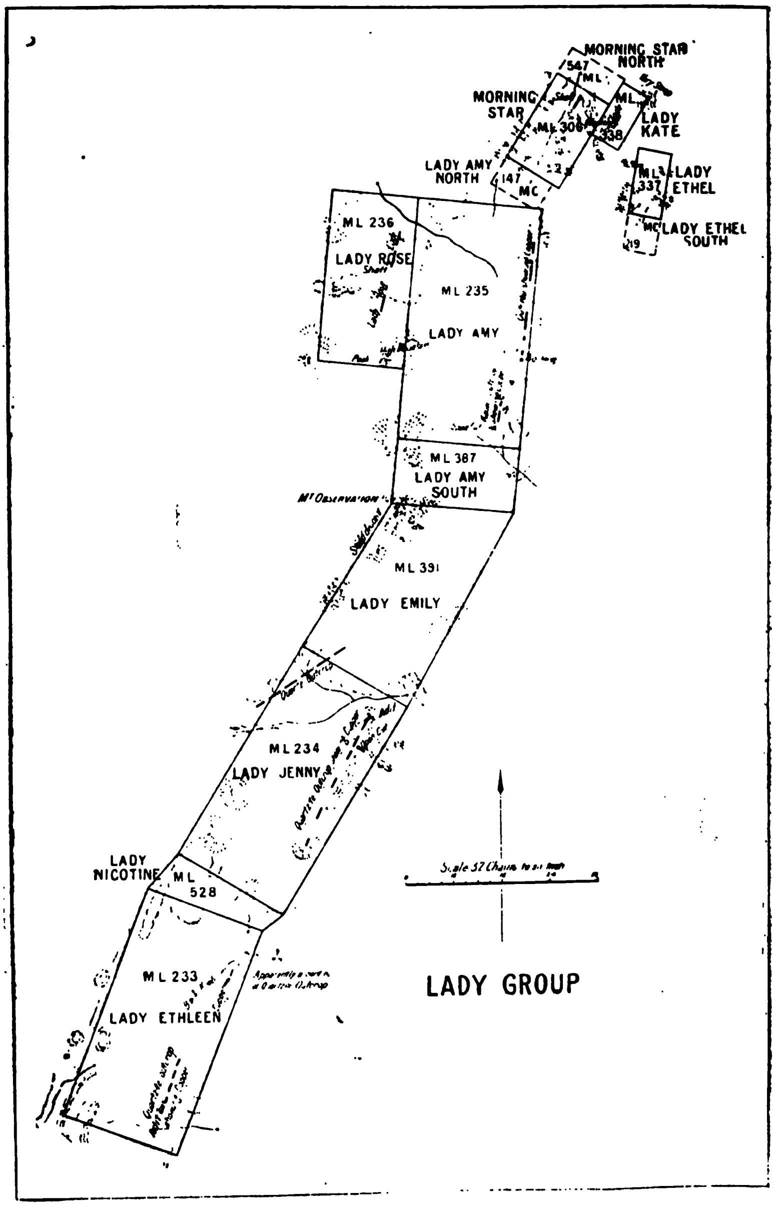
* Presumably glance is meant.

Morning Star North, Lady Rose, Lady Ethel South, Lady Ethel, and Lady Kate. Of these only the first, third, seventh, eighth, ninth, and eleventh were being worked.



The group extends along a precipitous range on the western side of Jimmy's Springs Creek, 38 miles west-south-west of Cloncurry and 5 miles south-west of the Springs Camp.

Lady Ethleen (M.L. 233).

Mgr., Moore.

LOCATION, ETC.

The Lady Ethleen is the southernmost of the Lady Group, and is 3 miles south-west of the Springs Camp.

Its area is 80 ac. The lease is held under option by the Queensland Exploration Company.

DEVELOPMENT.

An adit, in the eastern part of the lease, was 100 ft. in length*, when inspected, the approach being 24 ft. long.

ORE-BODY.

The main outcrop is on a ridge over 100 ft. above the level of the adit, which is being put in in a north-north-easterly direction, but is as yet in indurated slates with ironstains on cracks. The whole cap of the ridge, over a width of a chain, is iron-stained and silicified, the cupriferous gossany part being only 20 ft. wide and the copper content not more than 1%. Copper ore does not appear on the surface within 4 ch. of the adit mouth. There is nothing to indicate that rich ore except in bunches or thin veins will be found on the adit level.†

Lady Nicotine (M.L. 528).

Mgr., Moore.

LOCATION, ETC.

The Lady Nicotine adjoins the Lady Ethleen on the north.

Its area is 8½ ac. It is held under option by the Queensland Exploration Company.

ORE-BODIES.

The lease is on the Lady Jenny-Lady Ethleen line, but nothing has been done to prove it here.

Lady Jenny (M.L. 234).

Mgr., Moore.

LOCATION, ETC.

The Lady Jenny adjoins the Lady Nicotine on the north.

Its area is 80 ac. The property was being tested under option in November last by the Queensland Exploration Company.

DEVELOPMENT.

An opencut, near the centre of the eastern side of the lease, is 100 ft. in length, and its average depth at right angles to the surface is 7 ft.

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* At the end of December, 1906, the underground manager (Mr. McLeod) reported it to be 175 ft. in length.

† The underground manager informed me in December last that small and irregular but rich veins of ore had been met over a width of 12 ft.

An adit in the north-eastern part of the lease has an approach 20 ft. long, and is itself 155 ft. in length.* For two-thirds of its length it runs south-south-west, the inner third bending round to south-west-by-south.

A pothole sunk 1¼ ch. south of the adit has been filled in again.

ORE-BODIES.

A large outcrop of quartz runs north 30° east (dipping steeply north-north-westwards) along the eastern side of the lease, and several gossany outcrops have been found in the country adjacent to it on the east.

The long trench on the range top was opened to test this ground, the outcrop comprising quartzites and schists, the latter where crushed carrying malachite. The exposure, however, is very disappointing—decomposed schist, quartzite and altered porphyry (?), in places rather thin-bedded. There are thin veins of gossan and occasional lumps of limonite and chrysocolla, the richest not containing more than 1% copper, while the average of the whole length of the trench would not be above a trace.

The pothole south of the adit is in green-stained country rock, with much quartz. The ore is somewhat gossany, and is promising in appearance, but none of that now visible carries more than 15% copper.

The main crop pinches out 2 ch. south-south-west of the mouth of the adit. It is 50 ft. in greatest width, and consists of crushed schist and shattered quartz with limonite and malachite, the copper content in the richest parts being 10%.

The mouth of the adit lies between a gossany schist on the east and a big quartzite crop on the west, the adit itself being in quartz-veined chloritic schist striking obliquely across it to the south-south-east. One body of gossan, 10 ft. across, was met 5 ft. within the adit, and stains and bunches of carbonates appear 40 ft. from the mouth continuing for 20 ft. The ground is then barren quartzose slaty schist to near the face, where there is 5 ft. width of quartz and schist carrying gossan and stained by carbonates to the extent of 3% copper. The exposures are most unpromising, but, if any further work is done, it should be in following or sinking on the gossans instead of cutting across them.

There is no sign of fissuring here, the ore-bearing zones being impregnations of crushed country.

There is 1 ton of ore at grass—schist stained by chrysocolla and containing central nuclei of chalcopyrite enriched by chalcocite.

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* In December it had reached a total length of 210 ft., but was still in barren quartzite.

The outcrops are not worthy of any further attention. The ores on the surface are poor, and likely to be poorer below, as shown in the adit. If, however, any more work is to be done here in search of even medium grade ore, it should be in following the gossans. The wide outcrop on the surface south of the adit is similar in character to the Tharsis (Duck Creek), and considerable quantities of low-grade ore are therefore to be expected here.

Lady Emily (M.L. 391).

Mgr., Moore.

LOCATION, ETC.

The Lady Emily adjoins the Lady Jenny on the north.

Its area is 60 ac. It is held under option by the Queensland Exploration Company.

ORE-BODIES.

Nothing has been done to prove the ore-bodies on this lease, though the Lady Jenny crop and another enter it.

Lady Amy South (M.L. 387.)

Mgr., Williams.

LOCATION, ETC.

This lease lies between the Lady Emily and the Lady Amy.

Its area is 20 ac.

No prospecting has yet been done on this lease.

Lady Amy (M.L. 235).

Mgr., Moore.

LOCATION, ETC.

The Lady Amy adjoins the Lady Amy South on the north.

Its area is 80 ac. It is under option to the Queensland Exploration Company.

DEVELOPMENT.

One cut, 30 ft. in length, was opened about two years ago on the ridge top in the north-eastern corner, and there are two potholes on the southern boundary near the south-eastern corner peg.

ORE-BODIES.

The country here is highly altered slate striking north 15° west, any variation from vertical being to the westwards. Small isolated bunches of copper ore, of a few tons weight, occur in these slates, two of which have been exposed in the southern potholes, where there is 18 in. to 2 ft. width of cupriferous gossan dipping 3 in 1 to the north. About 5 tons of ore has been shipped from here.

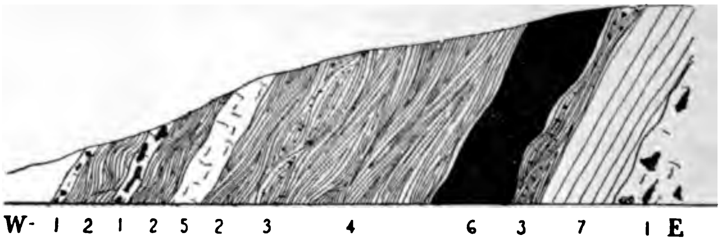

FIG. 21.—SECTION IN CUT LADY AMY.

Scale: 4 ft. to an inch.

1. Quartz and gossan
2. Schist
3. Ferruginous schist
4. Schist with ferruginous partings
5. Iron-stained quartz
6. Cellular gossan
7. Slate.

The big cut is in a green-stained and gossany crop, 30 ft. wide and consisting of alternate bands, dipping 60° to the west-north-west, of schist and quartz more or less iron-stained and resembling the Tharsis crush-zone. (See Fig. 21.) This can be followed down the hillside for 5 ch. to the south-west and up the hillside for 1 ch. to the north-east. The most promising part of the exposure is at the eastern end of the cut, where there is 3 ft. width of quartz and gossan separated from a 3 ft. band of cellular gossan by 18 in. ferruginous schist and 3 ft. slate. The cellular gossan should be sunk on, as it is likely to carry copper beneath the surface.

Lady Amy North (M.C. 147).

Mgr., Chaplain.

LOCATION, ETC.

This adjoins the Lady Amy on the north.

Its area is 600 ft. × 350 ft.

Two cuts are being opened 4 ch. apart.

OUTPUT.

Nov., 1905 ... 9 tons ore shipped.

ORE-BODY.

The southern cut exposes 9 in. cupriferous gossan dipping westwards.

In the southern cut a gossany formation, 3 ft. wide, can be seen in schistose slate. It is said that between 8 and 9 tons of rubble, carrying 35% copper, were obtained here, and have been shipped. There is now paddocked 1 ton of firsts and 1 ton of seconds carrying 15% copper.

Morning Star (M.L. 306).

Mgr., Chaplain.

LOCATION, ETC.

The Morning Star adjoins the Lady Amy North on the north.

Its area is 16 ac.

DEVELOPMENT.

The main shaft, 15 ft. deep, is near the northern end of the lease. A second shaft, also 15 ft. deep, lies 20 ft. to the east, and a third $2\frac{1}{2}$ ch. to the west, while a fourth, 15 ft. deep, lies 7 ch. to the south of the main shaft.

OUTPUT.

1906	...	$14\frac{10}{20}$	tons shipped	(Chaplin and Connlisk—source doubtful).
		$14\frac{18}{20}$	,, ,,	(Chaplin) ,, ,,
		12	,, ,,	(Chaplin and Glendenning—source doubtful).
		$1\frac{10}{20}$	,, ,,	(Chaplin, Smith, and Connlisk—source doubtful).
		$4\frac{10}{20}$	,, ,,	(Chaplin and party—source doubtful).
		$47\frac{8}{20}$*		

ORE-BODIES.

At the main shaft there is a gossany formation, 15 in. wide at the surface and 3 ft. 3 in. wide in the bottom, containing much azurite, as well as malachite, tile ore, and chalcopyrite enriched by chalcocite. The formation is in schist with lenticular quartz veins, and it strikes north 10° east, dipping 3 in 1 to the westward. About 20 tons of 35% ore are stated to have been shipped from this shaft, and there are 12 tons now at grass.

The eastern shaft is on a 4 in. seam of ore lying parallel to that in the main shaft. A bunch of ore found here contained 2 tons, yielding 40% copper.

The western shaft is in country, stained with iron oxides and copper carbonate, and is probably adjacent to a bedding plane striking north-north-east. It is on the line of strike of the ore-body seen in the Lady Amy. Some 4 tons of limonite-chalcocite (glance) ore, carrying 25% copper, have been shipped from here.

The southern shaft is in a formation 3 ft. wide and carrying up to 10% copper and little or no quartz, just to the west of a quartz and gossan blow. Practically all the material raised from the shaft is cupriferous, and, though no ore has been bagged from here, 3 tons, containing 20% copper, have been paddocked. Sinking should be continued here, and a crosscut opened eastwards.

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* At the end of 1906, Mr. Chaplain stated that 25 tons of 35% ore had been shipped, and there were then at grass 20 tons of ore, carrying between 20 and 35% copper.

Morning Star North (M.L. 547).

Mgr., Chaplain.

LOCATION, ETC.

This adjoins the Morning Star on the north.

Its area is 5 ac.

Two potholes have been dug on this lease, 3 ch. north, and 6 ch. north-east of the Morning Star northern shaft.

ORE-BODY.

Large outcrops of copper-stained quartzite on this lease strike south 5° east. At the north-eastern hole there is 2 ft. 6 in. width of formation, 5 ft. of schist, and 18 in. of gossan, quartz, and copper ore—a not very promising exposure.

Lady Kate (M.L. 338).

Mgr., Chaplain.

LOCATION, ETC.

The Lady Kate adjoins the Morning Star on the north-east.

Its area is 5 ac.

OUTPUT.

1905 ... 7 tons raised.

ORE-BODY.

In this lease there is a big crop of reddish quartzite on the joints of which a few small bunches of ore have been found with quartz.

Lady Ethel (M.L. 337).

Mgr., Chaplain.

LOCATION, ETC.

The Lady Ethel lies 10 ch. to the east of the Morning Star.

Its area is 6 ac.

There is one shaft, 10 ft. deep.

OUTPUT.

Total ... 6 tons shipped.

ORE-BODIES.

The country here is slate, striking north-by-west and dipping steeply west-by-south. Bunches of copper ore occur on joints and along the bedding planes, and in the latter case are sometimes connected by thin gossan leaders, even though ½ ch. apart.

The shaft was begun on a 2 in. leader of cupriferous gossan striking east and west. This leader is in a joint, and it opens out to 2 ft. width, where it crosses a ferruginous belt of slate. However, in all only 6 tons of ore were obtained here.

Lady Ethel South (M.L. 219).

Mgr., Chaplain.

LOCATION, ETC.

This adjoins the Lady Ethel on the south.

Its area is 400 ft. × 350 ft.

OUTPUT.

Total ... 14 tons shipped, carrying 35% copper[*] (*fide* Mr. Chaplain).

Lady Rose (M.L. 236).

Mgr., Moore.

LOCATION, ETC.

The Lady Rose adjoins the Lady Amy on the west.

Its area is 40 ac. The property when visited was under option to the Queensland Exploration Company.

DEVELOPMENT.

The only work done has been the sinking near the centre of the lease of a shaft 91 ft., where water was met.

ORE-BODIES.

The shaft is in country on the western side of a blow of quartz striking north 30° east and dipping 8 in 1 to the north-west. The blow is 4 ch. in length, 20 ft. in width, and stands 35 ft. out of the ground. It is slightly stained by malachite in parts, carries occasional bunches of gossan, and one or two patches of copper ore including cuprite were noticed on the western side, where also "copper weed" is growing. The indications, however, do not justify any further work here. The shaft at the time of my visit had just reached quartzite carrying crystals of pyrite.[†]

Ferruginous and copper-stained quartz crops 2 ch. to the south-west of the big blow, but is scarcely worth any further attention.

WEE MACGREGOR GROUP.

The Wee MacGregor Group lies less than a mile west of the Lady Group, from which it is separated by a practically inaccessible range. The leases lie some of them within the catchment area of Jimmy's Spring Creek and some within that of Cattle Creek, both of which are tributaries of the Corella. The former are connected with the Springs Camp by a fairly good dray road, but all stores for the latter have to be packed over the divide.

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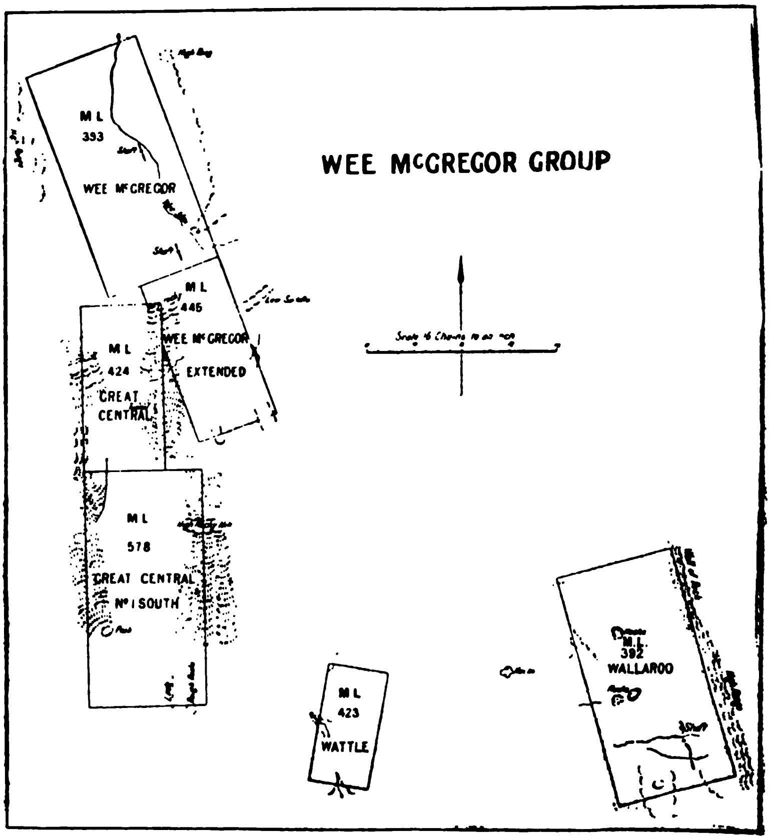
[*] This is reported to have comprised only surface boulders from various parts of the lease.

[†] Mr. McLeod, the underground manager, informed me in December that at 100 feet from the surface only barren quartz was exposed.

The country rocks comprise schists, quartzites, and an altered felspathoidal rock that may be porphyry.



The Great Central No. 1 North and No. 1 South and the Lord Nelson are included in this group, but work has not yet commenced on them.

Wallaroo (M.L. 392).

Location, Etc.

The Wallaroo lies 4 miles south-west of Springs Camp.

Its area is 20 ac. The ground is held by the Wee MacGregor Cloncurry Mines, Ltd.

Literature.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller reported:—

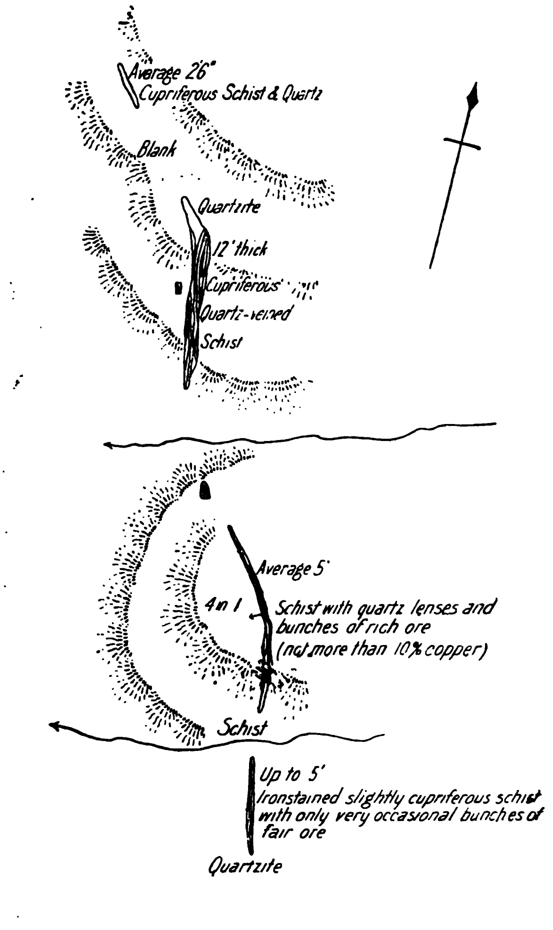
> The lode is traceable for 1,000 ft., and carries more or less copper almost the whole way. There are two principal outcrops of ore. One of these is 110 ft. long by 6 or 8 ft. in width. The ore occurs here in veins and bunches in a siliceous lode. A sample taken from this outcrop, omitting quartz, returned 31·6 per cent. The other outcrop of ore consists of a lens of gossan 70 ft. long by 15 ft. wide. A surface sample from this returned 20 per cent. copper.

DEVELOPMENT.

Work had only just begun in December last, one shaft having been sunk 17 ft. This is located 5 ch. from the southern boundary and 3 ch. from the eastern.

ORE-BODIES.

The ore-bodies here occur in five separate outcrops, extending over a total distance of 8½ ch. in a general north-by-west direction, the difference in elevation of the crops on the ridges and those in the gullies being 50 ft.


Average 26"
Cupriferous Schist & Quartz
Blank
Quartzite
12' thick
Cupriferous
Quartz-veined
Schist
Average 5'
4 in 1
Schist with quartz lenses and bunches of rich ore
(not more than 10% copper)
Schist
Up to 5'
Ironstained slightly cupriferous schist with only very occasional bunches of fair ore
Quartzite

SKETCH PLAN OF OUTCROP, WALLAROO

Scale of Chains

Over one half of the main crop is quartz, occurring as parallel lenticular veins, and one quarter is schist, the copper ore (malachite and limonite) occurring chiefly in the former where crushed, as on the Chinaman freehold and others at Duck Creek.

Iron-stained quartzite lies to the east of this outcrop, and reddish quartzites to the west of the shaft. The main crop strikes north-north-east dipping 3 in 1 to the west-north-west. Near the centre of the crop it is cupriferous over a width of 10 ft., and my sample contains cellular and clayey quartz-bearing gossan and dense limonite impregnated with malachite and chalcocite; chloritic schist veined with quartz and stained by malachite; and granular iron-stained quartz. It carries (Government Analyst):

Copper .. = 13·2%
Gold ... = 5 dwt. per ton.
Silver ... = 6 ,, ,,

The shaft is being sunk in schist 6 ft. to the west of this spot, and at the time of my visit had just struck bunches of ore, of which 1 cwt., estimated to carry 30% copper, had been raised—fine grained malachite and azurite with tile ore. Further sinking is warranted, as there is likely to be here large quantities of low grade siliceous sulphides below water level.*

The copper ore fails within 1 ch. to the south, but the quartz, which continues a little further in the schists, is still ferruginous. Northwards the crop increases to 12 ft. in width, and is rather more gossany, but after about 10 ft. it becomes siliceous and the end of the shoot may be taken as at 30 ft. from the shaft, though the quartzite is ferruginous for a further 20 ft. to the north-north-west.

The northern crop, similar in constitution to that at the main shaft, is 1 ch. beyond the northern end of the latter crop. It is 30 ft. in length, and averages 2 ft. 6 in. in thickness.

At 1 ch. south of the main crop there is a small cupriferous outcrop, and 20 ft. beyond it, to the south-south-east, is the boomerang crop, which is 2 ch. in length and averages 5 ft. in width, its peculiar shape being due to its dip and the contour of the ground. It consists of schist with quartz lenses and bunches of fairly rich ore—the latter carrying up to 10% copper.

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* A correspondent states in the "British Australasian" of 4th July, 1907, that in the crosscut from the main shaft at the 85 ft. level sulphides carrying 10 % copper had been proved over a width of 30 ft. Further it is mentioned that sulphides were being entered by the drive from No. 2 shaft (located 300 ft. south of the above).

The southernmost crop, ½ ch. to the south-west of the last, is 5 ft. in greatest thickness. It is composed of iron-stained, but only slightly cupriferous, schist and quartz, with only occasional bunches of fair grade ore. Beyond it to the south pinkish quartzite appears.

Wattle (M.L. 423).

LOCATION, ETC.

The Wattle lies 16 ch. west of the Wallaroo.

Its area is 5 ac. The ground is held by the Wee MacGregor Cloncurry Mines, Ltd.

Work had not begun here at the time of my visit to the group, and my time being short, it was therefore not inspected.

LITERATURE.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller has written:—

> The lode strikes 20° East of North, and dips to the West. It outcrops for a distance of 200 feet, showing Copper ore in several places. The principal outcrop of Copper ore is situated towards the south end of the lode, and consists of gossan and quartz carrying carbonate and oxide of copper, and a little glanz and yellow Copper. This outcrop is 20 feet long by 6 feet wide. A surface sample taken from here returned 19 per cent. Copper.

Great Central (M.L. 424).

LOCATION, ETC.

The Great Central is located south of the Wee MacGregor.

Its area is 10 ac. The lease is held by the Wee MacGregor Cloncurry Mines, Ltd.

LITERATURE.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller's report is as follows:—

> The lode is a very large one, about 100 feet in width, and composed at surface of gossan and quartz. . . . The western or hanging-wall portion of the lode appears to be mainly quartz, while the eastern or footwall portion is gossan. The gossan extends along the surface for 400 feet, containing more or less Copper the whole way, but the main shoot of ore is approximately in the centre. The gossan at this place is 70 feet wide, and appears to carry good Copper for the whole of this distance. Practically every stone broken carries good Copper, and most of it is of good grade. A rough sample taken right across the 70 feet, omitting only one or two small lenses of quartz, gave a return of 17 per cent. Copper. This good ore appears to extend along the lode for about 120 ft., though probably it does not maintain its full width of 70 feet for the whole of this distance. At any rate, the surface indications point to the presence of a large and rich ore-body in this lode, which deserves to be energetically opened up. . . .

DEVELOPMENT.

Work had not long commenced when this lease was visited in December last, there being then only an adit 17 ft. in length with an approach 30 ft. long. This is 1 ch. from the eastern boundary and 6 ch. from the southern.

ORE-BODIES.

A belt of schist, running nearly north and south and dipping 10 in 1 to the west, has here been found to be cupriferous over a limited area. This belt, which lies between two bands of quartzite, is 150 ft. in greatest width, and shows signs of great crushing. Lenticular quartz veins have been developed, and the intervening schists are very ferruginous, and in addition they are stained by malachite over the whole width. Southwards of the thickest part the copper ores are somewhat more concentrated, there being crops, 6 ft. wide and 30 ft. long, that will probably yield 10% copper, and give promise of being richer below.

Beyond a chain to the south, however, the iron and copper contents may be considered negligible quantities, and the place of the schist is taken by barren white quartzite. Northwards of the thickest part of the area the amount of copper in the schists decreases, and, at a chain distant malachite is found instead staining ferruginous cellular quartz on the line of the strike of the western quartzite band, which passes 1 ch. to the west of the mouth of the adit. The schists are quite barren at the mouth of the adit, which is being opened to prove the cupriferous country at a depth of 85 ft. below the crop, and is 2½ ch. to the north of the thickest portion. This work is warranted by the appearance of the hitherto untouched outcrop, from which it is to be anticipated that richer bunches, up to a chain in length and perhaps 10 ft. wide will be found, separated, however, by much barren country.

The cross vein mentioned under the description of the Wee MacGregor Extended passes about 5 ch. north of the adit, but was not noticed to extend further westwards. There is possibility of its being on a line of fault, and that the Great Central cupriferous zone is the southern part of the Wee MacGregor zone, which would necessitate a heave of nearly ¼ mile.

Wee MacGregor (M.L. 393).

LOCATION, ETC.

The Wee MacGregor lies on a branch of Cattle Creek, ½ mile north-west of the Wallaroo.

Its area is 20 ac. The lease is the property of the Wee MacGregor Cloncurry Mines, Ltd.

LITERATURE.

For title of report, numbered as below, see Introduction.

(12) Mr. Waller writes:

> This is a large lode, out-cropping at the surface for a distance of 1,000 feet. . . . The width of the lode varies from 6 feet to 15 feet, and may be even wider in places. The outcrop is composed of moderately soft but somewhat siliceous gossan, carrying more or less Copper in the form of carbonates and oxides, associated with occasional lenses of quartz. Of the 1,000 feet of outcrop, approximately one-half, or 500 ft., carries apparently good Copper. No work has yet been done on the lode, so it is at present only possible to speak of surface indications. These are of a highly promising character. A sample from the outcrop at the North end, taken by chipping here and there along the outcrop, returned 20 per cent. copper. At the South End the width of ore of this grade is at least 15 feet. A few very rich boulders of red oxide of Copper are to be seen at the surface at this point, assaying up to 80 per cent. Copper.

DEVELOPMENT.

Work was in the initial stages at the time of my visit in December. One shaft, near the centre and 2 ch. from the eastern boundary, was only 15 ft. deep; and the other, 2 ch. from the southern boundary, was 20 ft. deep.

ORE-BODIES.

The northern outcrop comprises crushed schist, veined with quartz over a width of 12 ft., and a length of about 1 ch. Stains of malachite are to be seen, but do not appear to extend below the surface. The crop is somewhat gossany, and this is the most promising feature about it. No trenching has been done, but the shaft is being sunk on the western side, the first 15 ft. of sinking having been in ferruginous decomposed slate, with slight stains of copper and occasional bunches of ore, rather more abundant and richer near the surface than in the lower part. A second crop, 1 ch. in length, occurs 1 ch. to the south-south-east on the line of strike of the above.

The southern crop extends from the shaft for 40 ft. to the north and 30 ft. to the south, the greatest width (8 ft.) being just south of the shaft, although malachite stains were noticed in the country over much greater widths. It is made up of crushed schist with veins of quartz and slight impregnations of malachite. The richer portions, which may be 2 ft. in thickness and which each contain a few tons, are expected to run 20% copper, but the crop as a whole will not yield more than 5%. The shaft is on the western (hanging-wall) side, and to 20 ft. depth, where much quartz was appearing, is in kaolinised country with copper stains, impregnations, and bunches. These bunches not infrequently have a kernel of cuprite or of cuprite and limonite surrounded by laminated malachite, the outer parts of which contain much clayey impurity. (See Fig. 22.) About 1 ton of ore has been paddocked and this consists of one-third ferruginous cuprite, one-third malachite, and one-third clayey impurity, the whole stained by earthy malachite and azurite and averaging perhaps 40% copper. The material from the shaft should yield at least 2% copper, earthy malachite occurring in the kaolin.

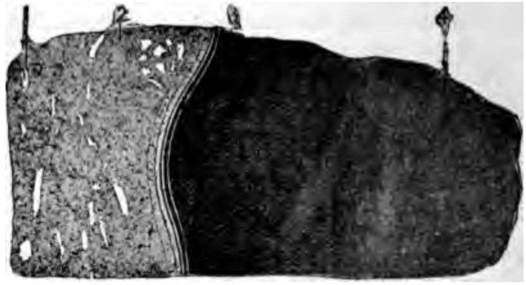


FIG. 22 (NATURAL SIZE).—OXIDISED ORE, WEE MACGREGOR.

1. Kaolin
2. Earthy malachite
3. Limonite
4. Cuprite (ferruginous towards the limonite).

Wee MacGregor Extended (M.L. 445).

LOCATION, ETC.

This adjoins the Wee MacGregor on the south-south-east.

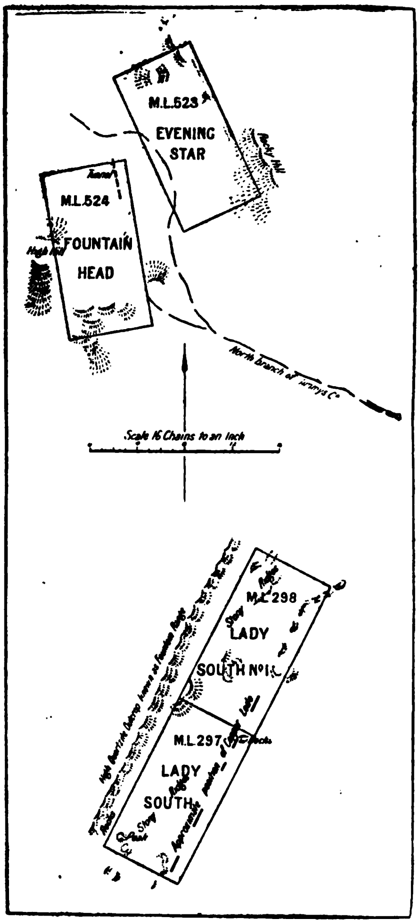
Its area is 8 ac.

ORE-BODIES.

The Wee MacGregor formation can be traced southwards into this lease, being here a ferruginous quartzite destitute of copper. An unusual occurrence here is that of a cross vein, which makes a prominent crop, dipping steeply northwards, for over ½ mile to the east of the formation. It is several feet in width, and, viewed from a distance, has a roughly banded structure, but closer inspection shows it to be composed of a network of veinlets of quartz in silicified slate. Much of the quartz has a chalcedonic texture, much is cellular, and a little has the "dogtooth" structure (sometimes in radiating rosettes).

LADY SOUTH GROUP.

The group includes, besides those mentioned below, the Lady South No. 1, the Evening Star, and the Hæmatite.



Lady South (M.L. 297).

Mgr., Donner.

LOCATION, ETC.

The Lady South lies just east of the Fountain Range, 1½ mile south-south-west of the Lady Ethleen and 10 miles south-west of the Springs Camp.

Its area is 10 ac.

ORE-BODY.

The surveyor's plan shows the outcrop to run north-north-east.

Fountain Head (M.L. 524).

Mgr., McCormack.

LOCATION, ETC.

The Fountain Head is on Jimmy's Spring Creek, 1¼ mile south-by-east of the Wallaroo.

Its area is 10 ac.

A tunnel has been opened in the north-eastern corner of the lease.

ORE-BODY.

An outcrop, striking north-by-west, is shown on the surveyor's plan.

MELBA GROUP.

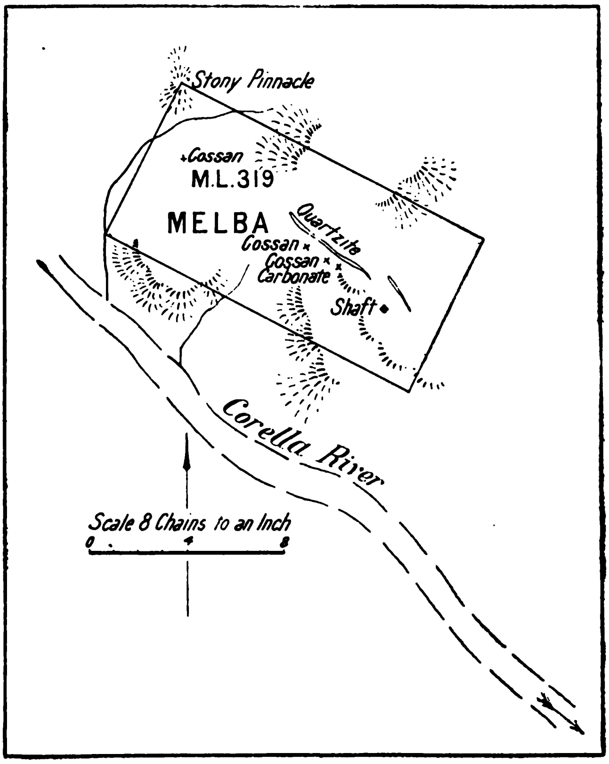
The group consists of only the Melba and the Rising Sun, the latter of which was not visited.

Melba (M.L. 319).

Mgr., Matheson.

LOCATION, ETC.

The Melba is situated on the western bank of the Corella River, 6½ miles west-by-north of the Springs Camp. The distance by the



dray track down the river to the Rosebud is twice the above. It is 3½ miles west-south-west of the Mona.

Its area is 10 ac. The lease is held by the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

A shaft has been sunk to a depth of 50 ft., and from it drifts have been opened 12 ft. north-west and 15 ft. south-east, and crosscuts 10 ft. north-east and 12 ft. south-west. This is in the south-eastern corner of the lease. One or two shallow holes have been made in the vicinity of the shaft, and there are two trenches near the centre of the lease.

OUTPUT.

1906	...	60 tons shipped, carrying 25% copper (manager's report)
		15 ,, seconds at grass.

ORE-BODIES.

There is little on the surface to indicate the existence of any quantity of rich ore here. A formation (that met in the eastern drive) is to be seen in a pothole 20 ft. north-east of the shaft. Ill-defined bunches of carbonate-bearing ore were noticed 2½ ch. north-west of the shaft, and gossan at 3, 4, and 10 ch. distant from the same. The trenches near the centre of the lease offer disappointing exposures and are apparently on separate lenses.

Most of the ore, which occurs in lenticular bunches, seems to have come from the upper part of the shaft. The ore-bearing seam passes out of the shaft to the east at 20 ft. from the surface, but comes in again at the shaft bottom.

In the north-western drive stringers and small lenses of slightly decomposed pyrite were noticed in schist, between two vertical partings 2 ft. apart. The south-eastern drive is in chloritic schist with some sintery lime towards the end. At the end of the south-western crosscut there is a formation of schist, 2 ft. 6 in. wide, partly replaced by chalcopyrite, now in process of alteration into limonite. It is ill-defined and not to be expected to last, even though the footwall country is somewhat slickensided internally. The north-eastern crosscut is in a loose granular siliceous formation having some resemblance to fault ground. Scattered through it are crystals of actinolite and crystalline country rock, and lumps of glance, with scattered grains of chalcopyrite, are stated to have been found in the more ferruginous portions, as well as nodules of malachite.

Further sinking to test this formation is warranted. The paddock at the shaft has 15 tons of poor seconds (limonite with scattered pyrite). The manager's reports state that 40 tons of 25% ore were obtained from within 14 ft. of the surface, but only 20 tons were obtained from the remainder of the sinking, driving, and cross-cutting.

SECRET GROUP.

Neither the Secret nor the Shakespear, the second lease in this group, was visited, and no particulars of interest being available, the latter is omitted.

Secret (M.L. 264).

Mgr., Matheson.

LOCATION, ETC.

The Secret is in a deep and narrow valley 4 miles west-by-north from the Springs Camp, and 3 miles south-south-east of the Rosebud.

Its area is 10 ac. This is held by the Willcocks Cloncurry Development Syndicate.

DEVELOPMENT.

Near the southern boundary a shaft was sunk 33 ft., and No. 1 crosscut opened from the bottom (16/9/05). Shaft 50 ft. deep (5/10/05) and No. 1 crosscut 27 ft. in; No. 2 crosscut, at 50 ft., in 12 ft. Shaft 95 ft. (21/5/06) and No. 3 crosscut 19 ft. in.

ORE-BODIES.

A formation, 22 ft. wide and carrying 11% copper, is reported* to have been met in No. 1 crosscut, and No. 2 crosscut proved 24 ft. of ore assaying 10·5% copper.† The last 7 ft. is said to be in cupreous iron pyrite.

ROSEBUD GROUP.

No particulars of the Nick of Time are available, and it has therefore been omitted from this record. None of the leases was inspected.

Rosebud (M.L. 266).

Mgr., Matheson.

LOCATION, ETC.

The Rosebud, on the northern bank of the Corella, is 4½ miles north-west of the Springs Camp. This is one of the leases held by the Willcocks Cloncurry Development Syndicate.

Its area is 10 ac.

DEVELOPMENT.

An adit has been opened 106 ft., and crosscuts opened at intervals of 25 ft. A winze has also been sunk 25 ft. below the adit. Opencuts are shown on the surveyor's plan on the southern boundary and 3 ch. to the north-north-west.

ORE-BODY.

There is an outcrop here, 20 ft. wide and 23 ft. high, striking north-by-west. The lode, alongside which is the adit, has been tested by cross-cutting, with results as follows‡:—No. 1 crosscut—8 ft. ore assaying 11·1% copper; No. 2 crosscut—15 ft. ore assaying 8%; No. 3 crosscut—20 ft. ore assaying 2·4%; and No. 4 crosscut—siliceous ore assaying 2·5%. These the manager considered unsatisfactory. The lode became very pyritous in the winze, but the copper value continued constant.

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* Warden's report for August, 1905. † Warden's report for December, 1905.

‡ Q.G.M.J., 15 Nov., 1905, and 16 Feb., 1906.

Mona (M.L. 520).

Mgr., Woods.

LOCATION, ETC.

The Mona is on the northern side of the Corella River, 4½ miles north-west of the Springs Camp. It is 12 ch. north of the Nick of Time.

Its area is 5 ac.

One shaft has been sunk near the centre of the lease.

OUTPUT.

1906	...	23 tons shipped.

ORE-BODY.

The surveyor's plan shows the outcrop striking north-north-west.

JUBILEE GROUP.

The Sunflower and Mountaineer have not been included here, as no description has been made of the ore-bodies. The group was not visited.

Jubilee (M.L. 460).

Mgr., Lobston.

LOCATION.

The Jubilee is on Running Creek, 8 miles north of the Springs Camp. It adjoins the Printy, and lies 3 miles north-west of the Imperial.

AREA.

Its area is 15 ac. The ground has been under option to Jacomb's Syndicate.

DEVELOPMENT.

There are two shafts on this lease—No. 1, 32 ft. deep; and No. 2, 46 ft deep. One of them is near the centre of the eastern side, the other near the middle of the southern.

ORE-BODY.

The surveyor's plan shows a lode striking north-by-east from the southern to the northern shafts and then north-north-west to the northern boundary. The outcrop is similar to that on the Springs—a formation carrying bunches of ore. The ore at 45 ft. in No. 2 shaft is said to have assayed 34·7%.

OUTPUT.

1904	...	$25\frac{18}{20}$ tons shipped (from Corella P.A.)
1905	...	18 ,, ,, (,, Jubilee and Printy)
	Total	$43\frac{18}{20}$,, ,,

Printy (M.L. 255).

LOCATION, ETC.

The Printy adjoins the Jubilee on the north.

Its area is 20 ac.

Some work has been done in the south-eastern corner.

ORE-BODY.

The ore-body worked is believed to be on the line opened in the Jubilee, the general strike of which in this lease is slightly west of north-north-west.

SUNSET GROUP.

Nothing is known of the nature of the May Day and Alice G. ore-bodies, and descriptions of the leases have therefore been excised. The group was not visited.

Sunset (M.L. 267).

Mgr., Campbell.

LOCATION, ETC.

The Sunset is on Green Creek, 10 miles north-by-west from the Springs Camp.

Its area is 20 ac.

The shaft was 30 ft. deep in December, 1906.

OUTPUT.

1906	...	26 tons at grass (5/3/06).

ORE-BODY.

Some 40% chalcocite ore is said to have been found here, but it is understood that development did not turn out well.

Sunset No. 1 North (M.L. 425).

Mgr., Copley.

LOCATION, ETC.

This adjoins the Sunset.

Its area is 10 ac.

OUTPUT.

1906	...	6 tons at grass (5/3/06).

Rosewood (M.C. 289).

LOCATION, ETC.

The Rosewood (or Sunset No. 1 South) is on Green Creek, 9½ miles north-by-west of the Springs Camp, and adjoins the Sunset on the south-east.

Its area is 10 ac. It is one of the leases held by the Willcocks Cloncurry Development Syndicate.

Lidster (M.L. 348).

Mgr., Entriken.

LOCATION, ETC.

The Lidster is 10 miles north-by-west of the Springs Camp.

Its area is 40 ac.

DEVELOPMENT.

An adit runs 10 ft. into the lode formation (5/3/06), in about the centre of the lease. This was put in by Jacomb's Chillagoe Syndicate.

ORE-BODIES.

Mr. Warden Cherry reported—"A very large copper-stained formation, with occasional patches of gossan and seams of ore." (5/4/06.)

Rose (M.L. 332).

Mgr., Allis.

LOCATION, ETC.

The Rose lies 10½ miles north of the Springs Camp.

Its area is 5 ac. It is held under option by the West Cloncurry Copper, Ltd.

Wilmot's Valley (M.L. 374).

Mgr., Wilmot.

LOCATION, ETC.

Wilmot's Valley lies 11½ miles north-by-west of the Springs Camp. It is a mile and a half north of the Sunset.

Its area is 10 ac.

DEVELOPMENT.

A shaft was 27 ft. deep, and driving was going on in December last.

OUTPUT.

1906 ... 10 tons shipped (reported).

ORE-BODIES.

The shaft is on the middle of three parallel outcrops, striking within a few degrees of north. There is reported to be a fair amount of 22% ore here, which it does not pay to ship.

ENQUIRY GROUP.

The King's Crown belongs to this group, but has been omitted on account of no particulars being available. The mines were not visited.

Enquiry (M.L. 265).

LOCATION, ETC.

The Enquiry lies on Green's Creek 10 miles north-west of the Springs Camp.

Its area is 5 ac. This is one of the Willcock's Cloncurry Development Syndicate's leases.

One small cut has been opened.

OUTPUT.

1906 ... 5 tons of fairly good ore at grass.

ORE-BODY.

The manager has stated that the Enquiry is of little importance. The cut exposes 3 to 4 ft. of copper-bearing formation, according to Mr. Cherry.

Snowstorm (M.L. 317).

LOCATION, ETC.

The Snowstorm is on Charley's Creek 12½ miles north-west of the Springs Camp.

Its area is 5 ac. The lease is under option to the West Cloncurry Copper, Limited, but has not been worked.

ORE-BODY.

The Snowstorm crop is reported to be a siliceous body of great width.

Feathertop (M.L. 316).

Mgr., Allis.

LOCATION.

The Feathertop is located on a tributary of the eastern branch of the Leichhardt River, 13½ miles north-west-by-north from the Springs Camp.

AREA.

Its area is 5 ac. The lease is under option to the West Cloncurry Copper Company.

ORE-BODY.

There is reported to be a big siliceous body here.

King's Cross (M.L. 426).

Mgr., Carty.

LOCATION, ETC.

The King's Cross is located 11½ miles north-by-west from the Springs Camp.

Its area is 20 ac.

The shaft was reported to be 15 ft. deep in December, 1906.

ORE-BODIES.

The ore is said to be of medium grade quartz and gossan. The shaft exposes over 4 ft. of lode apparently increasing in width. Warden Cherry states the country is granite (5/4/06).

MOUNT LIDSTER GROUP.

Little is known of any of the leases of this group.

Mount Lidster (M.L. 339).

Mgr., Entriken.

LOCATION, ETC.

The Mount Lidster lies 14½ miles north of the Springs Camp. It is 1 mile north-east-by-north from the Hidden Treasure.

Its area is 80 ac.

DEVELOPMENT.

There are two shafts here, 30 ft. and 60 ft. deep respectively (December, 1906), and sunk by Jacomb's Chillagoe Syndicate under option.

ORE-BODY.

The outcrop is stated to extend north-eastwards over 35 ch. on the lease, but the best ore is exposed at the northern end. One of the shafts is reported to have been sunk in country the other in gossany ore rich in copper.

Hidden Treasure (M.L. 362).

Mgr., Phillips.

LOCATION, ETC.

The Hidden Treasure is 13 miles north-by-west from the Springs Camp. It is 2 miles by track from Mount Lidster.

Its area is 5 ac.

The shaft is 15 ft. deep (Dec., '06). Idle.

OUTPUT.

1906	...	20 tons at grass (5/4/06). Some of good quality.

ORE-BODIES.

The Hidden Treasure, May Day, and Mount Lidster are understood to be all on one line.

Faded Rose (M.L. 357).

Mgr., Allis.

LOCATION, ETC.

The Faded Rose is 14 miles north-by-east from the Springs Camp, and adjoins the Roseleaf.

Its area is 10 ac. The lease is under option to the West Cloncurry, Ltd.

Roseleaf (M.L. 328).

Mgr., Allis.

LOCATION, ETC.

The Roseleaf adjoins the Faded Rose on the north-east.

Its area is 10 ac. The lease is under option to the West Cloncurry Copper, Ltd.

The shaft in December, 1906, was said to be 20 ft. deep. Idle.

CHARLEY'S CREEK GROUP.

This is the farthest out group, being really on Leichhardt waters.

Fuchsia (M.L. 326).

Mgr., Allis.

LOCATION, ETC

The Fuchsia is on Charley's Creek, 17 miles north-west-by-north from the Springs Camp.

Its area is 5 ac. The lease is under option to the West Cloncurry Copper Company. It is unworked.

ORE-BODY.

There is stated to be a large siliceous outcrop on this lease in which a little ore can be seen at intervals.

Copper Cross (M.L. 537).

Mgr., Richards.

LOCATION, ETC.

The Copper Cross is located on Charley's Creek.

Its area is 400 ft. × 350.

Sinking in December, 1906, was reported to be 20 ft. from the surface.

SOLDIER'S CAP.

Soldier's Cap is a typical mesa of Desert Sandstone resting on tilted slates of much greater age. The Cap is situated 17½ miles south-east of Cloncurry. The Mount Wheeler leases are on its eastern flanks, the other mines lying chiefly to the north-east.

MOUNT WHEELER GROUP.

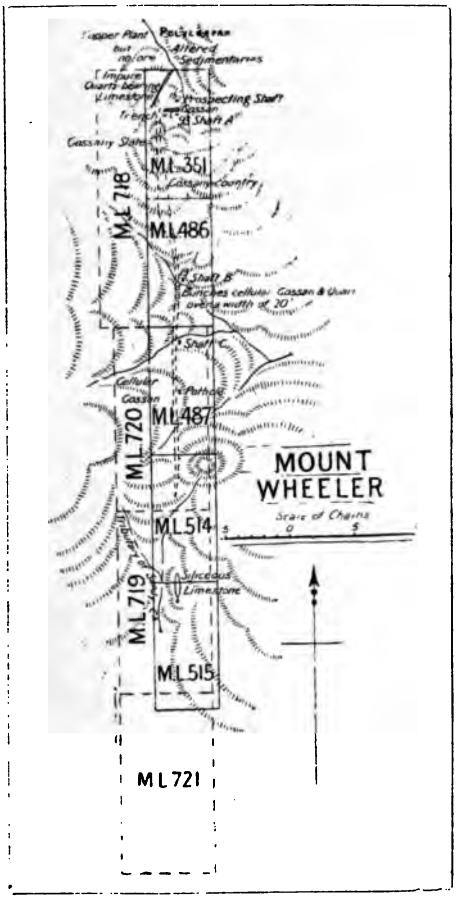
Included here are only those holdings actually seen or concerning which some particulars are available. The following have been omitted:—Forty-second (M.L. 605), Mount Lookout (M.L. 687), Ivy (M.L. 730), Sunrise (M.L. 613), Slate Hill (M.L. 725), and Chalkogen (M.L. 668).

Mount Wheeler (M.L. 351, Etc.).

Mgr., W. Paton.

LOCATION.

The Mount Wheeler leases lie on the eastern slopes of Soldier's Cap, 25½ miles south-east of Cloncurry, the distance by road being



32 miles. The country to the north of Soldier's Cap is beautifully rounded with rolling hills extending out to the rolling downs about 7 miles to the east.

AREA.

The surveyed leases are five in number, and each is 5 ac. in extent. They are from north to south: 351, 486, 487, 514, and 515.

Just before my visit application had been made to have the last three cancelled in order that three leases (Nos. 720, 719, and 721), each of 10 ac., might be repegged slightly to the west, but overlapping the old leases. At the same time application was made for a lease of 15 ac. (No. 718) to the west of Nos. 351 and 486. Though Mr. Paton gave cordial assistance, we had considerable difficulty in determining the extent of the old leases and the new ones had not yet been surveyed.

LITERATURE.

For title of report see Introduction.

(12) Mr. Waller says:

> The lode is a very large one; it is composed partly of gossan and ironstone and partly of dolomite and quartz, and occupies a zone of shearing in diorite. . . . It is stained with carbonate of copper at numerous points. The principal outcrop of ore is at the north end, where the zone of shearing is at least 200 ft. wide. The copper is contained in a seam of ironstone 6 ft. thick, crossing this formation almost at right angles. . . . The lode has been broken into in the bottom of this shaft, and carries 10% of copper ore for a width of 5 ft. . .

DEVELOPMENT.

The mine was under exemption when visited, and the underground workings were inaccessible.

M.L. 351.—The workings on M.L. 351 comprise one trench and two shafts.

The main shaft (A), in the northern central part of the lease, is 93 ft. in total depth (23 ft. vertical, and then underlying 1 in 1 to the south). At the bottom of the old filled-in part (25 ft. below the top of the underlie) a drive was carried 25 ft. west to intersect the north and south crop.

The prospecting shaft 15 ft. deep is 1 ch. to the north of A shaft.

M.L. 486.—The only opening on this lease is the shaft B, which is in the gully near the centre. It was sunk on an underlie of 1½ in 1 to the east, to a total depth of 80 ft., water level being 47 ft. below the surface. On the 50-ft. level crosscuts run 26½ ft. east and 6 ft. west; and on the 80-ft. level a crosscut runs 19 ft. east.

M.L. 487.—A pothole 3 ft. deep has been opened on the hilltop near the centre of the lease, and the C shaft, 19 ft. deep, is in the gully near the northern boundary.

GEOLOGY.

The country here, with the exception of the Desert Sandstone forming the upper part of Soldier's Cap, comprises highly altered sedimentaries, but the occurrence of the pneumatolitic mineral tourmaline* at the Shamrock gold mine, less than 2 miles to the north-north-west, proves that deep-seated igneous intrusion has taken place, this mineral resulting from after actions of the cooling magma.

There is consequently some reason for believing that the accumulations of copper ore may be due in part at least to the consequent activity of ascending solutions.

The leases are strung on a gossan-stained zone traceable in a general north and south direction from near the northern end of M.L. 351 into the middle of M.L. 514. On the continuation of the line a large crop of siliceous limestone crosses the southern boundary of M.L. 514. This, with the general character of the outcrops and the frequent occurrence of limestone in the ferruginous zone to the north, must be taken as evidence simply of the zone being the outcrop of a sedimentary stratum, and the presence of copper-iron ores in it is to be explained by the comparatively easy solubility of the limestone allowing of deposition of those ores even if it had no precipitative action on uprising solutions.

The main gossan crop in M.L. 351 runs out at right angles to the ferruginous zone, and is presumably on a joint or fissure.

ORE-BODIES.

M.L. 351.—The ferruginous zone may be taken to commence on the southern side of a north-north-east striking crop of quartzite, north of which no sign of ore other than abundant copper grass (*polycarpœa*) has been found. In this lease the zone consists of gossany slate, and in the southern part is a chain in width.

The trench to the west of shaft A exposes decomposed country, with stains and bunches of ore and gossan. A trial parcel was sent from here by the original prospectors (Pearce and McMorn), but no particulars are available as to its value.

A cross crop of slightly copper-stained gossan runs for over a chain east from the northern end of the zone above referred to, and bulged out to several feet in thickness at the eastern end.

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* The tourmaline occurs both in quartz and as masses of acicular crystals in granular and crystallised calcite, in which there are also occasional splashes of chalcopyrite and crystals of pyrite. Scheelite has been reported from here, but my search for the mineral was unsuccessful.

The old vertical part of shaft A went through this lode, while the underlie was sunk above it, but the well at the bottom of the latter proved 6 ft. 6 in. of ore, dipping 1 in 1 to the south. The ore at grass, about 15 tons, is granular limonite, with concentric light and dark blue chrysocolla in cavities, and stains of malachite on cracks. Native copper and gold have also been found in the more gossany parts. The ore runs up to 15% copper.

My rough surface sample from the heap at grass consists chiefly of dense earthy turgite and limonite, in which are occasional cubical casts of gothite after pyrite. Atacamite, malachite, and dioptase in very small quantity are scattered through the limonite, and they are also found as interlacing stringers, $\frac{1}{10}$-in. thick, and have sometimes been deposited in drusy form in cavities, the atacamite in a few cases forming crystalline aggregates, projecting $\frac{1}{8}$-in. from the wall. Mammilated chrysocolla fills most of the openings in the denser limonite, and also stains secondary silica; it varies in colour from very light to sky blue, in the former case being lustreless and very absorbent, in the latter vitreous and non-absorbent. A thin film of secondary silica has been deposited on the walls of open spaces in the more cellular gossan, and hyalite coats the surface of chrysocolla in the larger incompletely filled spaces. The sample contains (Government Analyst):

Copper	10·6%.
Gold	1 dwt. per ton.
Silver	2 dwt. 20 gr. per ton.

The prospecting shaft to the north of shaft A was begun on a formation 6 ft. wide and consisting of altered country with irregular bunches of gossan carrying chrysocolla connected by veins. The formation dipping $\frac{1}{2}$ in 1 to the south-east, the lower part of the shaft shows only iron-stained decomposed slates. There is about 5 tons of gossan with chrysocolla at grass, which will contain say 10%.

M.L. 486.—Passing into M.L. 486 the crop of kaolinised slate becomes siliceous as well as ferruginous, over widths of 10 ft. The slates, on the east of and adjoining the ferruginous zone, here carry small bunches of oxidised copper ore.

Shaft B was begun in the hanging-wall country—pyritous blue slate and white quartzite with bunches of calcite and some small irregular patches of chalcopyrite; but struck the "lode" at 50 ft. below the brace. The "lode," as far as could be seen from the tip, consists here of gossany and iron-stained quartzite. Mr. Paton informed me that it is 15 ft. thick, and that in one of the crosscuts sulphides (8% copper) were met over a width of 7 ft. On the 50-ft. level slates, over a width of 10 ft., have been replaced in part by cupriferous pyrite, but the average copper content is probably less than 1%. The stone at grass shows crystals of chlorite in both calcite and pyrite, the chlorite and calcite having presumably segregated from the country rock, after which replacement of the calcite by chalcopyrite has taken place. That the pyrite is residual from the leaching of chalcopyrite is indicated by its cellular structure, by the absence of limonite (showing that oxidation of the iron has not taken place) and by the presence of selenite, the result of the action on calcite of the sulphuric acid produced during the oxidation of the sulphide (Fig. 23).

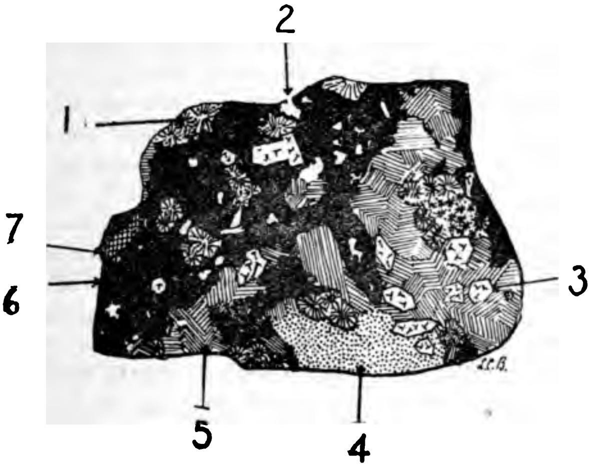

FIG. 23 (NATURAL SIZE).—PYRITIC ORE IN SLATE, B SHAFT, MOUNT WHEELER.

1. *Chlorite.*
2. *Cavity.*
3. *Quartz.*
4. *Country rock.*
5. *Cloudy calcite.*
6. *Pyrite (leached chalcopyrite).*
7. *Selenite.*

Just across the creek, to the south of shaft B, quartz-bearing cellular gossan appears, as irregular crops up to 5 ft. wide and 10 ft. long, in which slight stains of malachite can be seen. A gossany belt 6 ft. wide can be followed south from here.

M.L. 487.—The belt in the northern part, besides being ferruginous, shows considerable kaolinisation. Some bunches of finely cellular gossan were struck in shaft C, just to the south of which crops of that material—evidently irregular bunches—occur over a width of 20 ft.

The pothole on the hilltop to the south is on a crop of slightly copper-stained cellular gossan, 5 ft. and possibly more in width and 1½ ch. in length. Some inclusions of limestone can be seen, but little or no quartz. The gossany belt continues southwards. The sinking of a shaft here is most advisable, as indications are in favour of downward leaching and concentration of copper having taken place. The gossan seems to occur in detached lenses in the belt, and are to be prospected for by driving and cross-cutting.

M.L. 514.—The ferruginous zone continues a few chains into this lease, but no ore-bodies have been exposed. A second iron-stained zone, some chains to the west, is reported to run for miles to the south-south-west.

The limestone crop at the southern end of the lease is on the line of the ferruginous zone, though not visibly connected with it. It is 2½ ch. in length, over a chain in width, and rises 30 ft. above the ground. It consists of granular calcite, slightly coloured internally by oxide of iron and weathering slightly on the surface a dark-brown. Through it are scattered roughly developed elongated quartz crystals of all sizes, quartz being also present as massed crystals and as veinlets. A very little gossan is visible, but only minute traces of copper minerals. The greater part of the limestone is too siliceous for use as a flux, and, as the copper is not likely to increase with depth, the crop is apparently of no value. The limestone may either have been chemically precipitated on a zone of fracture, and therefore be an integral part of an ore-body, or may be a highly altered body of impure limestone—the latter being the more probale origin.

M.L. 515.—The limestone crop above described continues for over a chain into this lease, but no ore-bodies have been discovered. The limestone crop was pegged out 20 years ago by F. Wheeler for gold (?). On the summit is a depression filled with angular boulders, apparently a fallen-in cave, but its regular sides point to the possibility of its having been excavated by the early prospectors.

Shamrock (M.C. 184).

Mgr., Williams.

LOCATION, ETC.

The Shamrock is about ½ mile north-west of the Soldier's Cap battery, which is 29½ miles by road from Cloncurry.

Its area is 800 ft. × 350 ft. The claim was taken up by Williams early in 1906 for scheelite, but was unmanned when seen by me.

DEVELOPMENT.

The workings comprise a number of old cuts and shallow shafts, extending over a distance of 4 ch.

ORE-BODY.

The crop must have run north and south, parallel to and about 1½ ch. east of the line of the Rose and Thistle line, but no definite idea of its size can be formed owing to the collapse of the workings. It consists of hungry crystalline quartz and crystalline calcite, blocks of the latter in the tips being 2 ft. thick. In the calcite occasional splashes of chalcopyrite and crystals of pyrite can be seen, and the quartz is pierced by acicular crystals of schorl (black tourmaline). Scheelite has been reported to exist here in some quantity (up to 25% by assay), in the northern part of the reef, where schorl is most plentiful, but I was not able to detect any in the stone at grass.

The following is the result of partial analysis of a rough sample (Government Analyst):

Gold ... ... = trace (less than 9 gr. per ton)
Silver ... ... = 2 dwt. 9 gr. per ton
Magnesia... ... ... = 0·95%
Tungstic Acid ... ... = nil.

About 5 ch. north of the Shamrock workings traces of copper are visible in segregations of quartz and calcite occurring in crystalline sedimentaries.

May Graham (P.A. ?).

Mgr., Need.

LOCATION, ETC.

The May Graham is 4 miles west of Soldier's Cap.

Its area is 10 ac. This lease was not visited by me, owing to the inaccessibility of the workings.

The three opencuts—50 ft., 15 ft., and 17 ft. deep—have been allowed to fall in.

OUTPUT.

The Warden gives only:

1905 ... $9\frac{19}{20}$ tons.
1906 ... 1 ,, (but $20\frac{8}{10}$ tons, Need, Elder.)

Mr. Need, the manager, states that he has shipped:

Total—60 tons, averaging 30% (16 to 38%).

ORE-BODY.

The May Graham is reported to be a formation 2 ft. wide, in which occur bunches of ore consisting of oxidising chalcopyrite, chalcocite, cuprite, and native copper: and one specimen shown me contained molybdenite.

Weatherley (M.L. 699).

LOCATION, ETC.

The Weatherley lies 1 mile from the Government Well, and 2½ miles north-east of Soldier's Cap.

Its area is 10 ac. The Federal Reward Copper Company now holds the lease. The mine was idle during my visit, and was therefore not visited.

A trench 10 ft. deep is the only development.

OUTPUT.

2 tons shipped carrying 19% copper and 4 dwt. 18 gr. per ton gold.*

ORE-BODY.

A formation 7 or 8 ft. wide is said to carry copper, besides which there is ironstone and a heavy body of ferruginous quartz.

---

* *Vide* Federal Reward Copper Company's prospectus.

King Fisher (M.L. 700).

Location, Etc.

The King Fisher lies 1¼ m. north-east of Mount Wheeler.

Its area is 20 ac. Now the property of the Federal Reward Company.

One trench, 12 ft. deep, has been opened.

Output.

2 tons shipped, carrying 25¾%.*

Mackinlay (M.L. 698).

Location, Etc.

The Mackinlay is about 10 miles north-east of Soldier's Cap and ½ mile from Sandy Creek. It is shown incorrectly on the lease map.

Its area is 40 ac., and it is the property of the Federal Reward Copper Company. Not visited.

There is a shaft on southern boundary.

Output.

½ ton shipped, carrying 33% copper.*

Ore-body.

There is reported to be a carbonate-bearing formation 8 ft. wide, beside an ironstone gossan.

ROBERTS CREEK GROUP.

The Roberts Creek Group lies to the north-east of Soldier's Cap. None of the mines were visited, and it is doubtful if any are being worked. The leases include the following: Boska (M.L. 570), Elma (M.L. 546), M.L.T. (M.L. 476), and Victory (M.L. 525).

---

* *Vide* Federal Reward Copper Company's prospectus.

MARTIN CREEK.

The Martin Creek Groups lie between those on Duck Creek, the Florence River, and Soldier's Cap. The district attained some notoriety over the flotation of a gold mine, but has not yet produced much copper. Owing to the limited time available, the mines were not visited by me.

MOUNT McCABE GROUP.

This group includes only three leases.

Mount McCabe (M.L. 363).

Mgr., Pearson.

LOCATION, ETC.

The Mount McCabe is 3 miles east of the Cloncurry River and 2½ miles north of the old Last Call gold mine, which is 24 miles south of Cloncurry.

Its area is 10 ac. The lease is held on option by the West Cloncurry Copper Company, Limited, which began operations early in this year (1907).

LITERATURE.

For title of report, numbered as below, see Introduction.

(16) Mr. Bedford wrote as follows:

> This is one of the two true fissure lodes, or, rather, lode channels, on the field. The channel runs south-west and north-east, is 35 ft. wide and quite 800 ft. long. The metal is carried as black oxide in the veins, in a soft chlorite schist, but there are outcrops of specular iron also in the lode channel, which carry low-grade carbonates. Near the summit of the hill an opencut 8 ft. deep and about 6 ft. wide shows a few fine veins of black oxide of copper, but the schists are also impregnated with copper to an appreciable extent. There are many outcrops of iron present, principally specular, and a little as hematite and siliceous limonite. At its lower or northern end the ore channel is cut off by blows of carbonate of lime, which are heavily copper stained at intervals to the base of the hill. . . . A shaft is now down 60 ft., of which the last 45 ft. is in boulders of iron faced with malachite.

ORE-BODIES.

Mr. Cherry, the Gold Warden, after seeing the property, wrote: "The main outcrop strikes northerly and can be seen for a distance of over 200 ft., having a width of from 20 to 40 ft. The lode is composed of kaolin, limestone, and slate carrying copper, while seams of red oxide can be traced through the general formation. . . . Mr. Pearson informs me that the main lode bulks 12·64%."

From the manager's reports it is learnt that in sinking the shaft thin veins and nodules of schist were found to a depth of between

50 ft. and 60 ft., these giving place to "small veins of irony ore through the chlorite schist. A bulk assay from 65 ft. gave a return of 4·4% copper" (8/3/07).

Output.

1906 ... 4 tons shipped.

McCabe's Hill (M.L. 444).

Mgr., McCabe.

Location, Etc.

McCabe's Hill is located within the catchment of Martin Creek, but its exact position is not known to me.

Its area is $9\frac{8}{10}$ ac.

Output.

1905 ... 19 tons shipped.

Vulcan (M.L. 268).

Mgr., Entriken.

Location, Etc.

The Vulcan lies 1½ mile north-west of the old Last Call Gold Mine.

Its area is 10 ac.

Output.

The Warden, in August, 1905, reported:

51	**bags, valued at**	**£18**	**7**	**3**
68	**„ „**	**21**	**13**	**8**
47	**„ „**	**26**	**11**	**10**

1906, 7 tons shipped.

LEVIATHAN GROUP.

The Leviathan Group is situated on the northern side of Martin Creek, near the Cloncurry River. No particulars are available beyond the numbers of the leases (383, 384, 385), and 412, and their area (each $9\frac{8}{10}$ ac.).

ELDER CREEK.

The Elder Creek groups lie between Cloncurry and Soldier's Cap. Little or no work was going on here at the beginning of 1907, and none of the mines was visited. The ore deposits are reputed to be small and of little account.

MOUNTAIN HOME GROUP.

The group centres in the freeholds on Mount Norma, or Norna, and contains, besides those given below, the Come by Chance (M.L. 651), of which no particulars are available.

Mountain Home (M.F.s 2822, 2823, 2821, 2820, and 2659).

Location, Etc.

Mountain Home (M.F. 2821) is on the southern slopes of Mount Norna, which lies 17 miles south-east of Cloncurry; M.F. 2823 is on the northern slopes of the same mountain; M.F. 2822 is $\frac{1}{2}$ mile to the north-north-east; M.F. 2820 is 3 miles north-east of Mount Norna; and M.F. 2659 is $\frac{1}{2}$ mile north of M.F. 2820.

The following are the areas of the blocks:—2821, 2823, and 2822 are each 160 ac.; 2820 is 120 ac.; and 2659 is 40 ac. in extent.

Output.

1906 .. $14\frac{19}{20}$ tons shipped.

Literature.

For titles of reports, numbered as below, see Introduction.

(2) Mr. Jack's description is as follows:

> *Mountain Home.*—Mount Norma lies about 10 miles south-east of the Gilded Rose. It is a very conspicuous hill, especially as seen from the Hughenden road. It is of vertical slate (or rather shale) with a north-west strike, and is intersected with reefs or veins of quartzite. On its eastern side is the Mountain Home Copper Mine. The mine is one of the quartzite reefs above referred to, which runs north-north-west and is almost vertical, but has a slight underlie to east-north-east. The reef is seamed with copper ore, especially in the back (up hill). In the upper part of the lode, where the reef stands up like a wall on the hill side, the copper ore is represented by stains (stalactitic coatings) of green carbonate. The lode is a peculiar one in many respects, from the association of minerals. It yields green carbonate of copper, ferruginous red oxide of copper, enclosing numerous garnets, asbolane (manganese and cobalt) and numerous dendritic markings in binoxide of manganese.
>
> From the hardness and toughness of the siliceous matrix of the ore, the Mountain Home will probably be an expensive mine to work, but I should expect it to have a large output of ore of good quality. The labour conditions necessary for securing the land have been fulfilled for the most part by the construction of a dray road up the hill: and the mine is very little opened out.

(7) The following is taken from Mr. Rutherford's report:

> The Mountain Home (M.F. 2821) Mine is situated half-way up the eastern side of Mount Norma, a conspicuous hill 18 miles south-east from Cloncurry in a direct line. The "mine" consists of a 6 ft. by 4 ft. shaft sunk vertically 10 ft. and then 40 ft. on an underlay of 70 degs. to the east. The *raison d'être*

of the shaft is an irregular crack in the ferruginous sandstone, which is about 1 ft. wide at the surface, but peters out before the bottom of the shaft is reached. This probably carried copper: plentiful stains on the rocks at surface on the sides of an irregular excavation indicates the removal of a certain amount of ore from what must have been a bunch occurring at the surface. No other indications of ore were seen in the vicinity.

Lady Norma (M.L. 694).

Mgr., W. Carroll.

LOCATION, ETC.

The Lady Norma is on O'Toole Creek, 16 miles from the railway.

Its area is 20 ac. The Federal Reward Copper Company now holds the lease.

There is one shaft 50 ft. deep.

ORE-BODY.

There is reported to be a large crop of ironstone gossan and copper carbonates and 3 ft. of ore in the shaft bottom.

Elder Bornite (701).

Mgr., W. Carroll.

LOCATION, ETC.

The Elder Bornite is on the Elder River, 18 miles east-south-east of Cloncurry, 2 miles south of the Winton road, and 7 miles north-east of Mount Norna.

Its area is 10 ac. The Federal Reward Copper Company, which holds the ground, has not yet begun work here.

Lone Hand (M.L. 681).

Mgr., Wareham.

LOCATION, ETC.

The Lone Hand is 3½ m. north of Mount Norna.

Its area is 10 ac.

OUTPUT.

1906 ... 5 tons shipped.

ELDER GROUP.

The Elder Group comprises, besides those mentioned below, the Dromedary (M.L. 510), Laird (M.L. 464), and Montana (M.L. 372), particulars of which are not accessible.

Elder (M.L. 415).

Mgr., Wright.

LOCATION, ETC.

The Elder is located on the creek of the same name. Its area is $9\frac{8}{10}$ ac.

OUTPUT.

1906	...	**$20\frac{8}{20}$** tons.

Three Jokers (M.L. 463).

Mgr., Moniz.

LOCATION, ETC.

The Three Jokers lies 4 miles west of Mount Norna. Its area is $9\frac{8}{10}$ ac.

OUTPUT.

1905	...	**$3\frac{10}{20}$**	ons
1906	...	**4**	,,
Total ...	...	**$7\frac{10}{20}$**	

PUMPKIN GULLY.

This group is on the main Richmond road, between Cloncurry and the open downs to the east. A little work is occasionally done here, but, as most of the holdings were under exemption at the end of last year, it was not thought worth while to pay a special visit to the locality. The only workings seen, therefore, were those in immediate proximity to the road.

From my own rapid traverse of this part of the district the opinion was formed that it is an area of considerable metamorphism, chiefly of sedimentaries (including limestones), though eruptives are not wanting. The strata are tilted and the quartzites are interbedded with the slates.

Metamorphism has been less intense here than in any other part of the Cloncurry district—traces of fossils (*Stromatopora*) being distinguishable in the limestones. This may furnish an explanation of the comparatively small size of the ore-bodies—viz., that concentration of the copper has not been brought about owing to the original cupriferous silicates of the eruptives not having been broken up.

The following quotations may prove of interest, though not in agreement with my views.

(2) Mr. Jack refers in the following terms to the Pumpkin Gully country:

> Eastward towards the Mount Douglas mines, similar country prevails, with the addition of peculiar rugged knobs of granular quartzite. Unless these latter be the dicharge-pipes of "geysers" which poured out hot water containing silica in solution, I am at a loss to account for them.
>
> On the north bank of *Pumpkin Gully*, a copper lode (nearly vertical) runs from south-west to north-east. It has a large cap of red ironstone, and green fibrous carbonate of copper, with some very blue azurite. Part of the gangue (which is siliceous) is mixed with red oxide of copper and "grey ore" (sulphide of copper and antimony). The lode is traceable for a quarter of a mile across Pumpkin Gully; only one hole has been sunk, about four feet deep.

(4) Mr. Cameron, speaking generally of the Pumpkin Gully leases in 1900, said:

> . . . No attempt, however, has been as yet made to systematically prove the value of any of these leases, and up to the present no lode of any great importance has been discovered. The surface of the ground is comparatively level, and the copper outcrops are considerably concealed by surface accumulations. The outcrops are numerous and scattered, and often afford very rich ore. They are, however, small, and can as yet only be taken as indications of the presence of copper in the locality, whatever they may develop into when systematically opened up. The copper occurs as glance and carbonate chiefly, but also as red oxide, bornite, and chrysocolla in association with iron oxides. It is found generally in a hard siliceous matrix similar to that found at the old Cloncurry Mine, which runs in seams following the bedding of the slates and schists.
>
> On many of the leases no work of any kind has been done, though they show indications of ore. In most cases these indications consist of small patches of rich ore occurring in belts following the bedding of the country rocks. As these have not been opened out in any way their true significance is obscure, but they are certainly worth the spending of a little money in systematic prospecting work. . . .

The remaining leases in this neighbourhood show numerous patches of good ore in seams in the bedding planes of the country rock, but the outcrops are detached, and without, in many cases, even the removal of the loose boulders and *débris* of the weathered country rock, it is impossible to judge of their extent or their connection with each other. As far as I could see, none of them are indicative of true fissure lodes, but they are all apparently veins or impregnations of the country rock.

(7) Mr. Rutherford sums up:

> This group consists of small outcrops of quartzite, almost invariably associated with oxide of iron and stained with copper carbonate. They occur in country which is comparatively flat in schists and slates, and always follow the bedding of those rocks. The ridges in the vicinity are composed of sandstone often altered to quartzite, but still showing bedding. This rock, on examination, almost invariably shows stains of copper carbonate. It is my opinion that the copper has been leached out of this overlying sandstone and redeposited in a concentrated form along foldings and bedding planes of the underlying schists and slates. In no case did I see indications of fissure lodes. These small pockets, occurring as they do above water-level, are excavated without much expense, and, owing to the extraordinary richness of the ore, this pays to be carted to the railway. I consider the Homeward Bound group of leases of little value, as in most cases the ore bodies seem to have been mostly removed.

HOMEWARD BOUND GROUP.

This group includes the south-western leases.

Homeward Bound (Extended M.C. 331).

Mgr., Brown.

LOCATION, ETC.

The Homeward Bound lies about ½ mile east of Pumpkin Gully, and 12 miles east of Cloncurry.

Its area is 600 ft. by 350 ft. This claim and two small leases (Mount Douglas and Flying Dutchman) have been pegged out on the abandoned Homeward Bound lease.

LITERATURE.

For titles of reports see Introduction.

(2) Mr. Jack says only:

> Three hundred yards east of the Flying Dutchman is the *Homeward Bound* Copper Lode. It runs north and south. The shafts have become unsafe, but a little of the ore is lying about—green and blue carbonates, and some red oxide and native copper. The copper ore is said to have contained gold. A good deal of ore from this mine is stacked at the Queensland machine.

(4) Mr. Cameron wrote of the original holding:

> *Lease No. 158* shows an outcrop of ore called the Homeward Bound. An excavation about 30 ft. by 20 ft., and perhaps 6 ft. in depth, has been made on the surface of the ground, and good ore is reported to have been obtained from a shaft on the south-east corner of the excavation. At the north-west corner of this excavation a shaft has been put down 75 ft., and a drive from the south-east corner of the shaft goes east 30 degs. south for 17 ft., and then north 30 degs. east for 15 feet. There are highly-inclined slates striking about north-east in the shaft, and crystallised limestone and felspathic sandstone in the drive. There is no sign of ore or lode material. Ore is at present being obtained on the surface some 30 ft. east of this shaft, and about 20 tons have been stacked. The ore occurs as blebs of red oxide, glance, and radiating

> fibres of green carbonate in a siliceous matrix or quartzite. I could see no indications of a well-defined lode, nor does there appear at present to be any great body of ore. The outcrop is. however, considerably hidden by surface accumulations. An ore purchase-note from the Queensland Smelting Company, shown to me by Mr. Henry. as of ore from this outcrop, gave a return of 27·95 per cent. copper for a bulk sample of a few tons. The ore stacked could be easily picked to give a considerable amount of ore of this value. A few shallow trenches and shafts along the apparent line of deposition of the ore would soon serve to show whether the ore-body is continuous for any distance. The drive from the shaft mentioned above if continued a few feet would indicate whether the ore-body reaches down to the 75-ft. level, or whether it is merely a lenticular patch of ore at the surface of the ground.
>
> In the north-west corner of Lease No. 158 is another outcrop of copper ore on which a pit some 18 ft. deep has been sunk. It shows ferruginous and cupriferous quartzite apparently occupying a fissure striking about north 20 degs. east and dipping steeply to east 20 degs. south. The lode is about 2 ft. wide, and shows good copper ore. This lode is generally supposed to be a continuation of the Homeward Bound, though on what evidence I have been unable to determine.
>
> There is another shaft some 300 yards south-west from the Homeward Bound, but it has tumbled in. Some ferruginous green and blue carbonates with splashes of red oxide are seen on the surface.

(7) Mr. Rutherford states:

> An irregular excavation 30 ft. x 20 ft. and 4 ft. to 6 ft. deep has been made to remove this outcrop, from which 200 tons of rich ore are said to have been sent away. According to Mr. Henry, none of this ore assayed under 39 per cent., and was mostly carbonate and an intimate mixture of carbonate and glance (the result of oxidation of the glance) known locally as grey ore.' . . . In the south-east corner of the surface excavation an irregular hole has been sunk 12 ft. and a drive put in to north 45 degs. west for a distance of 20 ft. I was able to examine this drive, and found it to be in a felspathic sandstone showing green stains of copper carbonate on roof and sides leached out of the overlying outcrop, but I saw no ore nor lode formation. This seems to have been a lenticular deposit of rich ore at the surface. With the exception of a few tons lying at grass, all the ore seems to have been removed.

DEVELOPMENT.

On the southern side of the Richmond road an opencut, a trench, and a shaft are to be seen. The opencut, which runs north and south is 50 ft. in length and 15 ft. deep. An irregular trench 10 ft. in length lies 10 ft. to the south-east of the opencut. The shaft is 30 ft. deep and lies 5 ft. east of the opencut. These workings can scarcely be the same as those referred to above by earlier observers.

ORE-BODY.

Little can now be seen of the ore-body, except at the northern end of the opencut, where it is 1 ft. wide. Presumably there have been ill-defined bunches of ore, including limonite with radiating malachite.

Mount Douglas (M.L. 307).

Mgr., Moniz.

LOCATION, ETC.

The Mount Douglas is on the eastern side of the abandoned Homeward Bound lease.

Its area is 4 ac.

Flying Dutchman (M.L. 418).

Mgr., Crabb.

LOCATION, ETC.

The Flying Dutchman lies 10 ch. to the west of the Mount Douglas.

Its area is 5 ac.

LITERATURE.

For titles of reports see Introduction.

(2) Mr. Jack's report is as follows:

> Half a mile to south-south-east is the *Flying Dutchman.* It runs east and west and underlies to the north. The country is sandstone, with fine grains of mica. The matrix of the lode or reef is sandy (siliceous). The mine was originally taken up as a gold reef, and Mr. Macphail informed me that the stone, when crushed at the Queensland machine, averaged 1 oz. 3 dwt. of gold to the ton. All that remains to be seen at the shaft is a quantity of glassy quartz, with green fibrous (radiated) carbonate of copper, and some grey copper ore.

This probably refers to the western shaft on the Homeward Bound.

OUTPUT.

1904 ... 18 tons, shipped by Crabb; source doubtful.

King John (M.L. 417).

Mgr., Miller.

LOCATION, ETC.

The King John adjoins the old Homeward Bound on the north-west.

Its area is 5 ac.

Baroondah (M.L. 137).

LOCATION.

The Baroondah lies ¼ mile east of the Copper Quarry.

LITERATURE.

For titles of reports see Introduction.

(4) Mr. Cameron reported:

> *Lease No. 137* shows an excavation about 12 ft. long by 9 ft. broad and 5 ft. deep, from which some 3 or 4 tons of ore showing copper glance and carbonates in a quartzite gangue have been taken. About 140 yards to north 75 degs. west from this excavation is a trench, 5 ft. long by 3 ft. broad and 5 ft. deep, which exposes about 2 ft. of siliceous ore carrying ferruginous green carbonates. The country rock is siliceous schist.

(7) Mr. Rutherford reported:

> It shows an irregular excavation about 12 ft. long by 5 ft. deep in siliceous schist, from which a few tons of ferruginous quartzite stained with copper have been removed and are lying at grass. On the same lease 200 yards to the south-east 7 tons of 30 per cent. ore have been sent away from the surface.

Musical Union (M.L. 465).

Mgr., Brown.

LOCATION, ETC.

The Musical Union lies 1 mile south-east of the Copper Quarry. Its area is 5 ac.

Burleigh (M.L. 136).

LOCATION.

The Burleigh lies 1½ mile south-east of the Homeward Bound. It is now abandoned.

LITERATURE.

For titles of reports see Introduction.

(4) Mr. Cameron remarks:

> *Lease No. 136* shows a low ridge of hornblende rocks and limestone striking about north-west. Several small outcrops of copper ore are seen, but so far they do not appear to be of any great importance. The ore is chiefly peacock ore with earthy green carbonate and iron oxide, and occurs associated with quartz and calcite in what are apparently small veins following the bedding of the country rock.

(7) Mr. Rutherford wrote:

> It shows on the surface small veins of quartz carrying iron and a little copper, principally in the form of peacock ore. Several small trenches have removed most of the ore. The country is hornblende schist, and the quartz follows the bedding of the rock to north 30 degs. west.

Copper Quarry (M.L. 143).

Mgr., Brown.

LOCATION, ETC.

The Copper Quarry is 9 miles east of Cloncurry, and about ½ mile east-south-east of where the Richmond road crosses Pumpkin Gully.

Its area is 10 ac.

LITERATURE.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron wrote:

> *Lease No. 143* shows talcose schist striking east and west. A surface excavation on an outcrop of copper ore shows these schists to be heavily impregnated and replaced by copper glance over a width of about 5 ft., and some rich glance ore has been extracted. The schists show evidence of being copper bearing for some 35 yards in breadth south of this excavation, and for a considerable distance east along the strike of the beds. This outcrop holds out a prospect of being able to turn out a considerable quantity of glance ore that could be easily picked to assay 25 or 30 per cent. The occurrence of the ore is, however, irregular, as it has apparently been concentrated into masses here and there through the schist. It does not give much indication of its presence on the surface.

OUTPUT.

1904	...	26	tons, shipped by	Brown and party;	source doubtful
1905	...	9	,, ,,	S. Brown	,, ,,
	...	2$\frac{10}{20}$	,, ,,	S. Cowing	
1906	...	1$\frac{2}{20}$	,, ,,	S. Brown	,, ,,
		38$\frac{12}{20}$			

Raleigh Heights (M.L. 373).

Mgr., Carew.

Location, Etc.

The Raleigh Heights lies 5 ch. to the north-north-west of the Copper Quarry. The Richmond road crosses the southern corner of this lease.

Its area is 9$\frac{8}{10}$ ac.

Literature.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron wrote of the old lease:

> *Lease No. 139* shows a prominent ridge of altered and vertical felspathic sandstone about a quarter of a mile in length. A few potholes expose indications of copper here and there through the sandstone, but do not disclose any ore of value.

(7) Mr. Rutherford says:

> This area is taken up to include a metamorphosed sandstone ridge running north 80 degs. east. The sandstone is stained in places with green carbonate. A small hole into the side of the hill is completely cleaned out of any ore which it may have contained. I examined the whole ridge, but saw nothing beyond a few stains as mentioned.

EAGLEHAWK GROUP.

This group lies to the north of the Homeward Bound.

Eaglehawk (M.L. 454).

Mgr., Miller.

Location, Etc.

The Eaglehawk lies 3 miles west of the 18-Mile Hotel on Fisher's Creek.

Its area is 5 ac.

Literature.

(4) Mr. Cameron wrote of the old lease:

> *Lease No. 48* shows a pit sunk about 12 ft., on what is apparently a north-west and south-east lode. About 12 tons of ferruginous siliceous lode material containing large blocks of copper glance have been stacked. The width of the lode cannot be judged of, nor has its continuation been proved by prospecting work.

Output.

1906 ... 10 tons shipped.

Crow's Nest (M.L. 455).

Mgr., Miller.

Location, Etc.

The Crow's Nest lies $\frac{1}{2}$ mile south-south-west of the Eaglehawk.

Its area is 20 ac.

Salisbury (M.L. 142).

LOCATION.

The Salisbury lies 1 mile north-east of the Homeward Bound and within 5 ch. to the north of the Richmond road. The lease has now been forfeited.

LITERATURE.

(4) Mr. Cameron wrote:

> *On Lease No. 142* a shaft was sunk to a depth of about 20 ft. and a few tons of copper ore extracted. It shows blebs of glance and peacock ore with radiating fibres of green carbonate associated with quartz and calcite. There does not appear to be any great body of ore present, nor is it possible with the present prospecting work to determine the direction in which the ore-bearing material is running.

(7) Mr. Rutherford states:

> This is taken up on a small ferruginous quartzite outcrop showing copper stains. The only work done consists of a shaft, 16 ft. deep, which shows small ferruginous quartz veins following the bedding of the rock. No copper ore is seen in the shaft. The outcrop is said to have been worked for gold.

Cammie (M.L. 477).

Mgr., Miller.

LOCATION, ETC.

The Cammie lies 1 mile east-south-east of the Crow's Nest, and 1 mile west-south-west of the 18-Mile Hotel.

Its area is 5 ac. The ground was deserted in October, 1906.

LITERATURE.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron referred to the old lease thus:

> Of the group of leases lying further to the east, *Lease No. 66* shows a trench about 18 ft. in length and 14 ft. in depth, which exposes a seam of siliceous copper ore some 2 ft. to 3 ft. in width. The copper occurs as glance and carbonate associated with quartz and ferruginous silica. The ore occurs in slate, and runs with the bedding of the rock, which strikes here about east 30 degs. west.

DEVELOPMENT.

There is a shaft 15 ft. deep adjacent to the road.

ORE DEPOSIT.

A small lenticular bunch of very siliceous ore, containing cuprite and malachite and up to 3 ft. in width, has been removed from here. It ran east and west, while the altered sedimentary country, including micaceous-slate, strikes north and south, dipping steeply to the east.

This appears to be only one of many small bunches occurring in a ferruginous belt, distinguished by a very red soil.

King William (M.L. 462).

Mgr., Miller.

LOCATION, ETC.

The King William is understood to lie 2 miles south-south-east of the 18-Mile Hotel on Fisher's Creek.

Its area is 5 ac.

MONAKOFF GROUP.

This group includes only Freehold No. 15, which is located on a branch of Courtenay Creek, a tributary of the Williams River.

Monakoff (M.F. 15).

LOCATION, ETC.

The Monakoff lies 13½ miles north-east-by-east of Cloncurry.

Its area is 80 ac. The property is now held by the Monakoff Company, which pays a royalty to the Railway Company.

LITERATURE.

For titles of reports see Introduction.

(4) Mr. Cameron wrote:

> *The Monawagh Mine* is a prominent ridge of copper-bearing country, running in a north-east and south-west direction. The south-western portion, which is divided by a watercourse from the north-eastern, presents a wall of green-stained rock to the south-east. I am informed that an opencut at the north-east end of the ridge exposed a vein of copper ore about 2 ft. in thickness, interbedded with the schist. The ore is siliceous and ferruginous, and carries copper in the form of glance and tile ore. About 300 yards on the north side of the ridge a trench 35 ft. long, 3 ft. wide, and 8 ft. deep exposes a small lode of siliceous ore carrying bornite and glance.

(7) The following is taken from Mr. Rutherford's report:

> This property . . . consists of a prominent ridge of sandstone still showing bedding in places, and much contorted and altered to quartzite in others. The surrounding country is micaceous schist. Approaching this ridge from the north a lenticular hole 10 ft. deep at its deepest part and 30 ft. long was examined. According to the digger who showed us this property 18 tons of 37 per cent. ore were sent away from this excavation. The ore as usual was associated with iron and quartz. A heap at grass shows the iron impregnated with iron pyrites. Ascending the hill the sandstone ridge is reached. It runs 20 degs. south of east, and is stained in places a bright green with copper salts. Starting at the western end of the ridge along the line of outcrop, the first cutting is 15 ft. long by 12 ft. deep. It shows the sandstone to be soft and ferruginous, and reveals the staining of copper to be confined almost entirely to the upper part of the trench. Continuing east a hole 3 ft. deep is in barren sandstone. A second cutting shows quartzite 3 ft. across stained with carbonate. Beyond this cutting is a shaft which is said to have been sunk 50 ft., but has been filled up with *débris* to within 20 ft. of the surface. An examination of the waste dump showed nothing but the country rock. Farther to the north-east across a gully is a second bed of sandstone very similar to that just described, but no work has been done on it.

CHINAMAN CREEK.

Chinaman Creek occupies a wide flat-bottomed valley, which is bounded on the east by a low table-topped range, and on the west by the Corella peneplain.

CASSIDY' SWELL GROUP.

The group is on the eastern side of the Chinaman Creek valley.

The Poseidon has lately been taken up in the vicinity of the Thistle.

Thistle (Extended M.L. 248).

Mgr., Corney.

LOCATION, ETC.

The Thistle lies 2 miles south-south-east of Cassidy's 9-Mile Well, at the crossing of the Boulia road and telegraph line, on Chinaman Creek.

Its area is 1,200 ft. by 350 ft.

DEVELOPMENT.

A costean (No. 1 cut), 5 ft. deep and 7 ft. long, has been opened 2 ch. south-east of the north-western corner peg, and a drive continues 6 ft. from the eastern end. At 1 ch. to the south there is a shallow pothole, 10 ft. beyond which is No. 2 cut. This is angle-shaped, being 6 ft. deep and 4 ft. wide, with one arm running 10 ft. west and another 8 ft. south. A second pothole lies ½ ch. south of No. 2 cut, and the main shaft, ½ ch. to the east, is 70 ft. deep, and has a cross-cut for 34 ft. east at the bottom.

OUTPUT.

¾ ton shipped.

ORE-BODIES.

The country is bluish clay-slate,* dipping 2 in 1 to the east. This rock has suffered alteration, and is shattered over a distance of at least 3 ch. from the northern end of the claim and over a width of 1 ch. near the main shaft. An outcrop of schistose micaceous and granular hæmatite, 1 ch. long up to 25 ft. wide, and rising 4 ft. above the surface, occurs on the eastern boundary of the claim 2½ ch. east of the shaft. Occasional boulders of yellow jasper, possibly replaced limestone, and also of limonite, are to be seen, and some copper stains can be distinguished, but no body of copper ore is to be expected here. Other crops of hæmatite have been found 4 ch. to the south, and they are reported in numbers in the low range, ¾ mile to the east.

In No. 1 cut a gossany crop has been opened to 5 ft. depth, where the formation is barren, though 2 tons of gossan and slate, stained with azurite and malachite, and containing probably 10% copper and 5% silica, was obtained from irregular joints near the surface. There are only stains of copper carbonate in the drive.

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* The kangaroo lickholes on the flats north-west of the claim are of interest. They are trenches 18 in. long by 6 in. wide and 6 in. deep, as well as holes 6 ft. deep. The soil here is reddish and clayey but tasteless.

The pothole to the south is in bleached clay-slate, the joints of which have been filled or stained with carbonates, and about 1 cwt. of 5% ore has been picked out. The country between this hole and No. 1 cut is a ferruginous slate, the joints of which are coated with black limonite.

No. 2 cut is in bleached and iron-stained clay-slate, with a little gossan and carbonate and silicate stains on joints. There are, at grass, about 4 tons of 5% ore, and 18 cwt. of 45% ore is said to have been shipped, while the 15 tons in the tip probably contain 1% copper, and may be of value as an aluminous flux.

The shaft is sunk on the eastern side of a formation, 10 ft. wide. There is little probability of anything payable being found here, but the open ferruginous joints indicate the possibility of the formation being copper-bearing towards water level. The result of driving has been disappointing because of faulting throwing the formation, proved in No. 2 cut, back from the shaft.

A tongue, 20 ft. across, of formation, comprising slate fragments in a ferruginous matrix, projects towards the hæmatite crop for 1¼ ch. east of the shaft.

The southernmost pothole is in poor siliceous ore.

TOWN.

GREAT AUSTRALIA GROUP.

The group includes chiefly freeholds. The Great Australia is the only lode of importance.

Great Australia (F. Al.).

Mgr., G. E. Moore.

LOCATION.

Freehold A1 adjoins the township of Cloncurry on the south, the Great Australia workings lying a mile south-east from the main business area.

The major part of the holding is low-lying, the Great Australia and Mount Pisa ridges forming the most marked rises, and the Wanderer Creek the most noticeable depression.

Of timber larger in size than brush there is of course little left, because of mining and smelting operations in past years, and the needs of the township.

AREA.

The area of the freehold is 640 ac., and it is square, each side being therefore a mile in length.

The property is now in the hands of the Queensland Exploration Company, Ltd., whose manager was absent during my inspection.

HISTORY.

The Great Australia was taken up, as a 640 acre mineral selection, by Mr. Ernest Henry prior to 1868 (according to records in the Warden's Office), but is now held as freehold under the Mineral Lands Act of 1872. The first work was done in 1871 by Mr. Henry, who sank several shafts to water-level, and despatched rich ore to Normanton.

In 1884 a company was formed, took over the mine and began mining operations, the number of men employed numbering between 200 and 300.

During 1885, 60 men were employed. Smelting, in two water-jacket furnaces of 50 tons capacity, was initiated, with the use of charcoal fuel; and 253 tons of ore were smelted, the copper produced being free from arsenic.

During 1886, only 40 men were engaged, but 200 tons of copper were shipped, *viâ* Normanton, the cartage to that port being £6 per ton.

In 1887 the number of men employed fell to 18, but 1,010 tons of ore were raised during the first half of the year, and 190 tons of copper were run from the furnaces.

Early in 1889 work ceased because of the low price of copper, and the mine then lay idle for 17 years.

Towards the end of the year 1906 the Queensland Exploration Company, which had taken over the property earlier in the year, began cleaning up the old workings.

From Press reports it is learned that during the present year the main shaft, south of the big crop, has been sunk 112 ft. (17/4/07), in formation carrying stringers of native copper. The tunnel shaft, 117 ft. deep, appears to have passed through the ore bodies (proved in the adit—L.C.B.), which have been tapped in a western crosscut, 27 ft. long; but the eastern crosscut, 100 ft. long, seems to have failed to locate ore.

LITERATURE.

The full titles of reports will be found in the Introduction.*

(1) The Wardens gave a statement of output, but no account of the deposit worked.

(2) Mr. (now Dr.) Jack describes three lodes:—(*a*) forming the main crop one-fourth of which Mr. Jack estimated would contain 35%; and (*b*) and (*c*) cross lodes. In the last were exposed masses of red oxide of copper often intimately mixed with small nuggets of native copper and occasional crystals of black oxide of copper. The following is the full account:

> The "*Great Australian*" Copper Mine lies between the last-mentioned ironstone hill and the township. It may almost be described as a mountain of copper. It occurs as a ridge about 30 feet in height and over 100 yards in length, with a general trend from north to south. It is intersected by two cross lodes, and has several branches. A detailed description is in preparation. At present I can merely say that numerous trenches and shafts only lead to the conclusion that "there is no end to it." The most valuable ore is the red oxide, which is obtained in great purity, and often contains large masses of native copper. The cap of the lode is composed of a siliceous matrix with green carbonate.
>
> *Lode A.*—The most conspicuous feature of the mine is the outcrop of a lode, which runs north 33 degrees west, and stands up to an average height of about 20 feet above the general level, for about 80 yards. The lode underlies to west 33 degrees south, at an angle of 50 degrees. The matrix is a brownish quartzite, very tough and hard, and frequently enclosing small pieces of native copper, interspersed through the matrix irregularly; but as a rule, in veins parallel to the general run of the lode, are masses of green carbonate of copper and red oxide, the latter often in crystals, and as nearly as may be, chemically pure. The ore has been quarried to a small extent on the crown and south-western side of the hill. If the whole hill were quarried out I believe that on a rough estimate quite a fourth of the entire mass would yield ore containing 35 per cent. of copper and over, after the rejection of the siliceous matrix and portions of ore too much mixed up with the matrix.
>
> *Lode B.*—At the S.E. end of the hill the A lode is shifted about 90 feet to the S.W. by a cross lode (B) whose course is east 40 degrees north. This cross lode is traceable for over 100 yards to the N.E. of the lode A, but the first 20 feet or so are obscured by a talus of *débris* from the outcrop of lode A. Lode B is nearly vertical, but underlies a little to north 40 degrees west. Its most conspicuous feature is a rock, 32 feet in length, 8 feet broad, and averaging 6 feet in height. This rock is a mass of quartzite like that which forms the matrix of lode A, and has joints and pockets coated with

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* Messrs. Jack and Rutherford give particulars of another lode (the Wanderer) on the freehold, but this was not inspected by me.

green carbonate of copper. To west 40 degrees south of the rock and in the same line, the cap of an ironstone and copper lode extends for 17 feet, when it passes under the talus already referred to. At the other end of the rock (to east 40 degrees north), the lode is traceable, either *in situ* or in blocks, for 260 feet. Lode B occurs in a line of fault with a downthrow to the north, and is of later date than lode A.

To the south of lode B, lode A is continued in a general direction of south 10 degrees east, for a distance of about 24 yards. It appears here to be narrower and poorer (at the outcrop) than on the other side of the cross lode, and to bifurcate towards the south end.

Lode C.—The south end of this (which may be called the second section of lode A) is intersected by a second cross lode (lode C) running east 35 degrees north. This lode has been worked open-cast for about 110 feet to east 35 degrees north from the crossing of lode A. The ground rises in this direction, and the present face of the working is about 20 feet high. The lode varies from 2 to 12 feet in width and is nearly vertical. The faces and sides of the workings expose masses of red oxide of copper of great purity, often intimately mixed with small nuggets of native copper. Occasional crystals of black oxide of copper are met with in this cutting. The oxide is traceable for a considerable distance beyond the working.

What may be called the third section of lode A extends in a general direction of south 15 degrees east from lode C. It has been worked open-cast for about 50 feet from the crossing of lode C, and has yielded much rich ore. The south face of the open-cast shows a mass of very pure red oxide bound together by masses of native copper.

From this open-cast no work has been done for the next nineteen feet (though the lode is visible on the surface), when an underlie shaft has been sunk on it, in rich ore. The lode is untouched for about 40 feet from the shaft, when it is again worked open-cast for a distance of 90 feet. The workings here have tumbled in, but enough is still seen to prove that the lode continues undiminished in size, and yields rich oxide ores.

(4) Mr. Cameron brings Dr. Jack's description up to date 1900 thus:

Since Mr. Jack's visit an open cut has been worked along the centre, and apparently the richer portion of the main outcrop mentioned as Lode A, starting from its north-western termination and going in a south-westerly direction along the line of lode. The open cut is about 15 feet across, and starts from a point about 20 feet above the base of the outcrop. It runs in a south-easterly direction for about 70 feet, ending in a face some 20 feet in height. This face shows red oxide and native copper in splashes through a brown quartzite. Several small stacks of ore are lying about at the foot of the outcrop, and appear to have come from the tunnel. They seem to support the view that the ore can be easily picked to a high percentage. The ore-bearing portion of the outcrop, as shown by the sides of the open cut, dip to west 33 degrees south at about 60 degrees. A tunnel has been driven in, apparently with the intention of meeting the ore body at a lower level than the floor of the open cut. It makes an acute angle with the direction of the open cut, starting from the western side of the outcrop and going almost due east. It is 18 ft. across, 8 feet high, and about 60 feet long. It does not appear to have reached to the main ore body. The walls show hard brown quartzite with veins of white quartz, and they are stained green from copper salts leached from the surrounding rock. Otherwise they do not show indications of containing a payable proportion of copper. About 15 feet from the mouth of the tunnel a drive goes in to the right for about 30 feet, and meets a shaft from the surface here only a few feet up. The shaft is continued down for a distance of about 40 feet. None of these workings, except the open cut on the outcrop of the lode, appear to be in ore of much value, and no further work appears to have been done on the main outcrop of Lode A north of where Lode B crosses it.

South of the junction of Lode A with Lode B the outcrops described by Mr. Jack are a confused mass of neglected workings, tumbled-in shafts, mullock heaps, and decayed surface structures. One of these shafts is said to have been 160 feet in depth. They are, however, all inaccessible, and it is impossible to gain any reliable information as to the character or value of the lode met with in them. The workings would require a considerable sum of money to put them in order. . . . .

I was unable to get any reliable information as to the value of the ore in the lower levels, but it appears that the water level was reached and sulphide ore obtained. The smelting of the ore seems to have been the difficulty that was never satisfactorily overcome, and this failure, together with the drop in the price of copper, are the causes to which is attributed the closing down of the mine.

(6) Messrs. Rutherford and Kitchener in describing the geology of the No. 1 Freehold, say:—

> The country is flat and consists of felspathic slate standing nearly vertical. Overlying the slate and scattered irregularly over the surface is a metamorphosed sandstone highly contorted and completely altered to quartzite in places. The ore occurs (1) in a bed of vitreous yellow quartzite, which stands up 30 ft. above the general level for a distance of 80 yards, and (2) in the slate associated with iron oxide and quartz in a succession of lenticular deposits to the south-west. . . . It is possible some rich pockets of ore may still remain undiscovered, but the expenditure which would be entailed prospecting for these would be greater than any return which could legitimately be expected.

(12) Messrs. Alex. Hill and Stewart gave few details beyond the amount of seconds at grass and the contents.

DEVELOPMENT.

The Great Australia workings comprise three opencuts, an adit and nine shafts. Only the northern cut, the adit and tunnel shaft were accessible to me.

The northern opencut, on the big crop, is 30 ft. long, 20 ft. wide, and 10 to 15 ft. deep.

The main opencut, to the south-east of the big crop, and between the main northern and Tangye's shafts, really represents stoping done from the water-level.

Tangye's opencut is a fallen in stope to the south of Tangye's shaft.

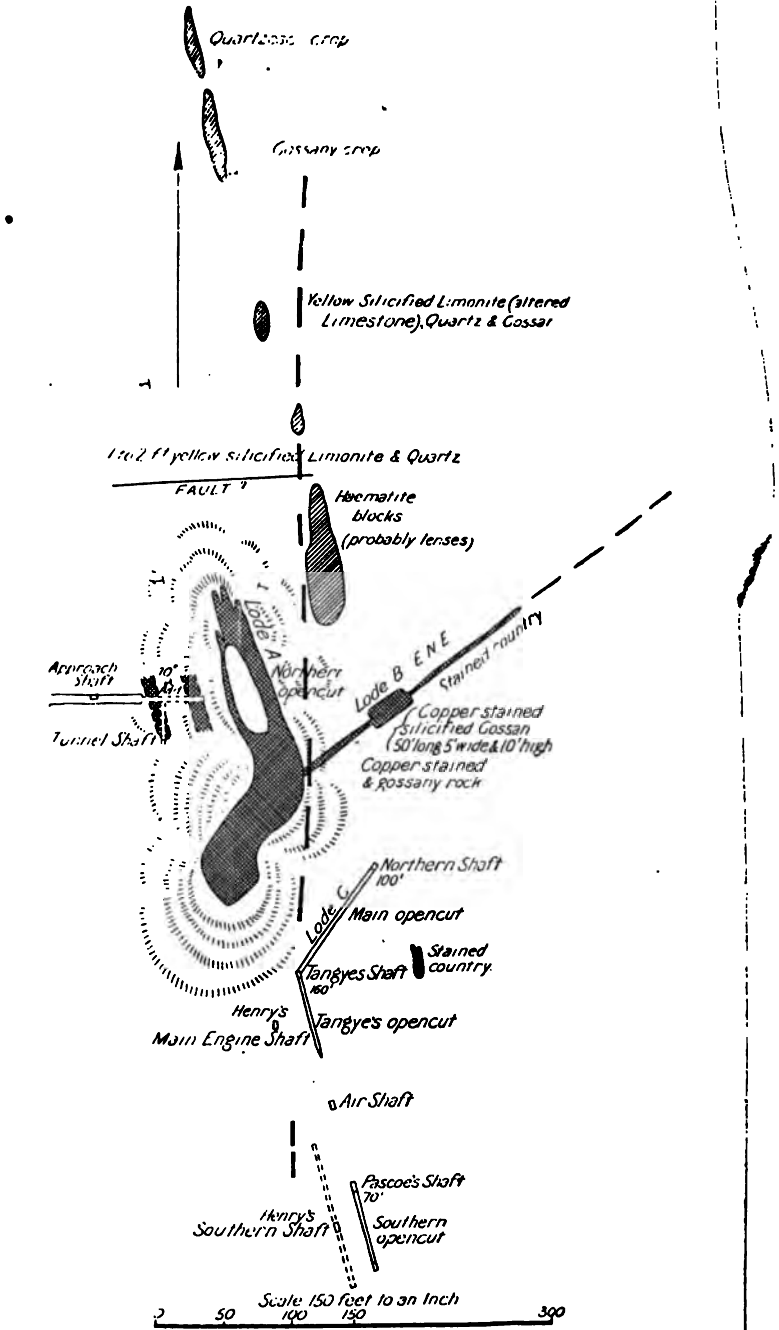
The southern opencut, a chain in length, also represents collapsed stopes south from Pascoe's shaft.

The adit, which is 15 ft. wide and 8 ft. high, was opened on the western side of the main crop, evidently with the idea of testing it beneath the surface. The approach is a chain in length, and the adit itself 40 ft. At 12 ft. from the mouth of the adit a drive runs southwards for 25 ft. to the Tunnel shaft.

The Approach shaft is an old one half-way along the approach to the adit on the northern side.

The vertical Tunnel shaft, 6 ft. by 3 ft., 25 ft. south of the adit, was left when 50 ft. deep by the former holders. The present management had at the time of my visit cleaned it out, and continued it to 57 ft. below the surface, and had begun a crosscut (12 ft.) to the west, at the 50 ft. level.

The Northern shaft, a chain to the south-east of the main ore body, and 3 ch. south-east of the adit, is 100 ft. deep, and is now inaccessible. There is understood to be at 70 ft. depth a short drive northwards, and one southwards to Tangye's shaft, above which the ore has been stoped to the surface.


Quartzose crop
Gossany crop
Yellow Silicified Limonite (altered Limestone), Quartz & Gossan
1 to 2 ft yellow silicified Limonite & Quartz
FAULT ?
Haematite blocks (probably lenses)
Lode A
Northern opencut
Lode B E N E
Stained country
Copper stained silicified Gossan 50' long 5' wide & 10' high
Copper stained & gossany rock
Approach Shaft
10°
Tunnel Shaft
Northern Shaft 100'
Lode C
Main opencut
Stained country
Tangyes Shaft 160'
Henry's Main Engine Shaft
Tangye's opencut
Air Shaft
Pascoe's Shaft 70'
Henry's Southern Shaft
Southern opencut
Scale 150 feet to an Inch
0
50
100
150
300

SKETCH PLAN, OUTCROPS AND WORKINGS, GREAT AUSTRALIA.

Tangye's underlie shaft (inaccessible), 1½ ch. south-south-west of the Northern, is 160 ft. deep, the main levels being at water-level (75 ft. below the surface), but there are believed to be shorter drives at a still greater depth. The old stopes to the south have now collapsed.

The underlie Air shaft is 1½ ch. south of Tangye's, but is inaccessible, and no particulars are available as to its depth.

Pascoe's underlie shaft, 1 ch. beyond the air shaft to the south, is 70 ft. deep. The old stopes, extending for a chain south of this shaft, have now fallen in forming an opencut.

Henry's old vertical shaft, to be known in future as the Main Engine shaft, lies ½ ch. south-south-west of Tangye's shaft. This was sunk a few feet below water level (70 ft.) by Henry, and under the present management had, when seen by me in January of this year, been cleaned out 15 ft., and cut down to 10 ft. by 4 ft. in the clear.

Henry's southern vertical shaft (inaccessible) 1½ ch. south-south-west of Pascoe's, is 80 ft. deep, and at the bottom there are levels 60 ft. north and 50 ft. south.

OUTPUT.

No records prior to 1884.

1885—253 tons ore, yielded	60 tons copper
1886	200 ,, ,,
1887	190 ,, ,,

The Warden mentions that 1,340 and 1,010 tons of ore were raised during the years 1885 and 1887, but makes no reference to any output in 1886 and 1888. The total raised probably exceeded 3,000 tons.

The ore now at grass is stated to be 740 tons, and its average contents is, according to Messrs. Alex. Hill and Stewart, 13·12% copper.

The seconds from the opencut amount to 130 tons, averaging 8·8% copper.

GEOLOGY.

Country.—The country rock west of the workings dips westwards and consists of schist, that to the east dips east-south-east, and comprises highly altered sedimentaries, with lenses of spotted calcite. The spots in the calcite represent crinoid joints, and indicate its organic origin.

Lenses of limestone, 2 ch. in length and 6 ft. wide, have been worked in shallow quarries ¼ mile north of the mine. The rock consists, with the exception of a few bands, of pure crystalline grey marble. There are indistinct indications of crinoid joints, proving its sedimentary origin—as against secondary segregation from the country rock.

Besides the small crops* of hæmatite to the north of the mai workings, referred to under the description of the Ore-bodies, the free hold includes a comparatively important crop at Pisa Hill, describe elsewhere in this report.

There is a possibility of the strata between Mount Leviathan an Pisa Hill having been bent into a deep synclinal fold, and in that case the iron ore-bodies cropping on opposite sides may all occur in one stratum, though they will of course have no direct connection.

The association of hæmatite and sulphides is strong evidence i favour of the ore-bodies being genetically due to regional meta- morphism, but there is some further evidence of extensive faulting at the Great Australia, allowing of the introduction of copper fron deeper seated regions.

Ore deposits.—The main crop at the Great Australia consists of a great number of bunches of ferruginous ore, distributed through the country, but the bodies stoped may possibly be on lines of fault. In their present state an inspection cannot be made and my conclusions are therefore indefinite.

Mr. Jack first described lode B as on a line of fault, but it is not certain as to whether he also considered lode C to mark a fault. There is in fact a probability of the latter lying along the bedding of the country. Evidence of still another fault is available. This is an east and west crop 1 to 2 ft. thick, of silicified limonite, 2½ ch. north of the adit. It would thus appear that the main outcrop lies between two faults, and is intersected by a third. Further, the divergence in the general strike of the country east and west of the workings indicates that there is also a more extensive north and south fault to the east of the main crop. This is more likely than any of the others to have provided a passage for solutions which, on rising, passed out along the more shallow faults and along the bedding planes of the adjacent upended strata.

ORE-BODIES.

The ore bodies are described below in the order of their importance:—

Main ore-body.—The main crops at the Great Australia are in a hillock, 5½ ch. in length and 3 ch. in greatest width, rising to 40 ft. above the adjacent plain. The greater part of the hillock is composed of silicified ironstone (really ferruginous secondary silica) and cupriferous slate, dipping 70° to the west-south-west. On the cap of the ridge there is only slightly silicified limonite stained with copper, and this is generally spoken of as the main crop (lode A of Mr. Jack). It may be taken as 3½ ch. in length, gradually fraying out within 1½ ch. north of the adit, and ½ ch. in width, though not sharply divided from the country alongside. It has the shape of a boomerang, being sharply bent near the southern end. In the northern opencut no ore richer than 10% in copper can now be seen, but there is of course a possibility of rich bunches raising the average much above this.

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* The attached plan shows wrongly a large lens north-east of the northern open-cut, there being instead probably a number of small lenses here.

In my opinion it will be found that the ore occurs in big lens-shaped masses here, and that when one pinches out one or more others will be found on sinking, crosscutting or driving. The ore bodies here seem to occur at no great intervals, presumably owing to the major and minor faults referred to under "Geology." At the present time it cannot be affirmed that the ore in sight is payable, but the probabilities warrant sinking to water-level at least, and then crosscutting and driving.

The approach to the adit exposes ferruginous altered slates, dipping westwards 70° and containing bunches of limonite, over a width of a chain.

The adit itself reveals two ore-bodies. The first, 12 to 15 ft., consists of gossan, with occasional bunches of copper ore; then across the drive to the south there is 15 ft. cupriferous and gossany altered quartz-bearing country rock, beyond which to the face is found dense limonite, with thin seams of malachite. There is no sign of fissuring, but even if there had been fissures one would not expect to find much evidence in such softened country as this. There can be no doubt that this gossan will be found to pass down into low-grade pyrite—containing perhaps 5% copper.

The approach shaft was sunk in copper-stained limonite; and there are about 60 tons of that ore stacked adjacent to it, but part of this may have come from the adit.

The tunnel shaft, at 56 ft. depth, passed out of a body of dense limonite in decomposed greenish country, with irregular bunches of cuprite-limonite ore up to a foot in diameter. The western crosscut proves the limonite body to be at least 12 ft. wide, and to have scattered through it grains and lumps of quartz, and besides to be slightly stained by malachite. The ore at the 50-ft. level is undoubtedly poor, but there is every probability of richer being found at water-level, below which sulphides may be expected in quantity. Only about 5 cwt. of ore, limonite rich in cuprite and malachite, had been paddocked.

The Central Ore-body.—Mr. Jack's lode B runs off north-east nearly at right angles to the main crop at the bend, and can be traced for 3 ch., chiefly as stains in the country. At a distance of a chain from the main crop it projects 10 ft. above the ground, and for over ½ ch. has a width of 5 ft. It is composed of silicified gossan, only slightly copper-stained. Mr. Jack states that lode B occurs on a line of fault, but I had no opportunity of verifying that observation.

The Southern Ore-body.—Mr. Jack's lode C, which is south of the main crop and converges, as indicated by the main open cut, towards lode B, may be either on a line of faulting or else on a bedding plane.

The main engine shaft is being sunk in the foot-wall (the eastern side) of an ore body, but some bunches of limonite containing cuprite have been obtained in cutting down the shaft. (Later, see "History.")

Eastern Ore-bodies.—Copper-stained country is found about a chain east of the southern workings, and on the flats to the north and north-east of the main crop numerous bodies of hæmatite outcrop as well as cherty yellow siliceous rock, quartz and slightly cupriferous gossan following the general strike of the western country. A gossan crop of some promise lies abut 5 ch. distant from the northern end of the main crop.

Conclusions.—From the descriptions given above, it will be seen that in the present state of the workings it is not possible to calculate even the probable amount of ore available here, and no estimate can be made of the average tenor of the ore. Nevertheless, it can be stated that the deposits are worthy of thorough trial, and the developments only now being undertaken with the idea of blocking out the deposits are in every way warranted.

No. 11 (M.F. 11).

LOCATION, ETC.

Freehold No. 11 adjoins the township on the east and the A1 freehold on the north.

Its area is 80 ac. It is the property of the Queensland Exploration Company.

No outcrops can be seen here, owing to the covering of alluvium.

No. 12 (M.F. 12).

LOCATION, ETC.

Freehold No. 12 lies between the township on the west, M.F. 19 on the east and M.F. 11 on the south.

Its area is 80 ac. It is now in the hands of the Queensland Exploration Company.

No outcrops can be seen here, the whole being a residual and alluvial flat.

No. 19 (M.F. 19).

LOCATION, ETC.

Freehold No. 19 lies to the east of the township, from which it is separated by only M.Fs. Nos. 11 and 12.

Its area is 628 ac., and the greater part of it has now been cut up into residential allotments.

No ore-body has yet been found on this area, which comprises both residual and alluvial flats and stony ridges.

No. 13 (M.F. 13).

Location, Etc.

Freehold No. 13 touches M.F. 19 on the north-western corner and lies just north of the township of Cloncurry.

Its area is 80 ac. It is held by the Queensland Exploration Company.

Ore-bodies.

No outcrop was seen on this holding, though the Company's plan indicates a small "outcrop" near the northern boundary.

No. 14 (M.F. 14).

Location, Etc.

Freehold No. 14 lies 1½ mile north-north-east of the township.

Its area is 80 ac. The Queensland Exploration Company now holds this ground.

Literature.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford speaks thus of freehold No. 14:

> Like the Wanderer's, it consists of low disconnected ridges of indurated sandstone, which can be followed for a distance of 300 yards in a north-east and south-west direction. The country in the neighbourhood consists of similar low ridges of metamorphosed sandstone lying on the schist, but the presence of iron and silica in the "outcrop" seems to have determined the deposition of copper along this line. I examined nine trenches along the ridge, which all showed the rock stained in places with green carbonate. Two shafts, one 30 ft. deep and the other 16 ft. deep, show nothing beyond what is seen in the trenches. No body of ore can be seen on the property, though rich nodules of red oxide can be broken off here and there from the outcrop. A heap at grass near the 30 ft. shaft might, if picked, yield 1 ton of good ore. This little bunch of ore occurring at the surface probably determined the position of the shaft.

Development.

The workings, which are in the south-western part of the freehold, comprise a shaft 35 ft. deep, three trenches at 1½ ch., 3½ ch., and 5 ch. to the south-west, and a pothole 10 ft. deep, 1½ ch. beyond. During the second half of the year 1907, four shallow shafts have been sunk by the Company.

Ore-bodies.

The workings are on a more or less cupriferous and ferruginous quartzose crop, striking generally north-east and south-west, between crushed quartzites and schists to the south-east and ferruginous quartzites and schists to the north-west. Towards the south-west the crop—nearly 20 ft. across—is very siliceous, and is poor in copper, but, iron oxide being abundant, an improvement may take place in depth. "Floaters" of native copper and cuprite have been found in the soil over a width of 50 ft. on the trenched part of the ground, but no defined body of ore has been located.

The north-eastern trench is in dense limonite with copper stains and impregnations of secondary sulphide, warranting further work here.

The main shaft was sunk on a band of silicified limonite in clayey gossan. All firsts have been removed, but there are at grass about 2 tons of seconds—siliceous limonite with stains of malachite and thin veins of cuprite—containing not more than 5% copper.

The manager has reported the results of the work done on this freehold during 1907 to be very disappointing, and prospecting was therefore abandoned in September.

Cave Canem (M.L. 456).

LOCATION, ETC.

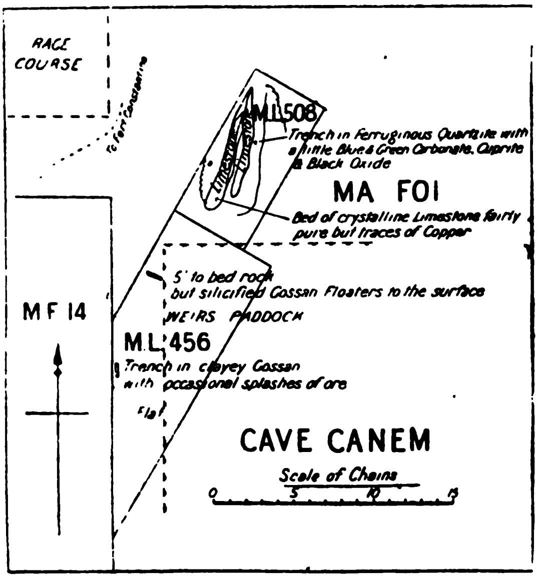
The Cave Canem adjoins M.F. 14 on the east, its distance north-east from the township being 1½ mile.

Its area is 9⅕ ac. Under exemption when visited.

Only two shallow trenches have been opened on this property, one half-way along the north-western boundary and the other 5 ch. south of the north-western corner.

ORE-BODIES.

No ore-body has yet been exposed, practically the whole of the base being covered by alluvium. At the northern trench silicified gossan floaters were found from the surface to bedrock 5 ft. below. This siliceous rock is similar to that found in the vicinity of the Great Australia and other lodes in the district, and may generally be considered as replaced limestone.


RACE COURSE
to Fort Constantine
M.L. 508
Limestone
Limestone
Trench in Ferruginous Quartzite with a little Blue & Green Carbonate, Cuprite & Black Oxide
MA FOI
Bed of crystalline Limestone fairly pure but traces of Copper
5' to bed rock but silicified Gossan Floaters to the surface
WEIRS PADDOCK
M F 14
M.L. 456
Trench in clayey Gossan with occasional splashes of ore
Flat
CAVE CANEM
Scale of Chains
0
5
10
15

In the southern trench can be seen a clayey gossan, with occasional splashes of copper ore as well as the siliceous rook. Further trenching is therefore warranted here.

This lease would seem, from the evidence available on the Ma Foi, to be on a calcareous zone, where precipitation of copper ores is likely to have taken place.

Ma Foi (M.L. 508).

LOCATION, ETC.

The Ma Foi adjoins the Cave Canem on the north-east.

Its area is 5 ac. Under exemption when visited.

There is one shallow pit on the western boundary, and a trench near the centre of the lease.

ORE-BODIES.

No ore-bodies have yet been found here, but the geology is interesting.

A belt, 1 ch. wide, of fairly pure crystalline limestone, with traces of copper, runs for 5 ch. north-north-eastwards along the north-western boundary of the lease, and is overlapped by a second thinner bed, 7 ch. long, reaching within 1 ch. of the northern corner peg. To the east of the limestones, ferruginous quartzites have been trenched and shown to be in parts gossany and stained by malachite and azurite, while vugs are lined with quartz crystals, coated with black oxide.

There is no sign of any quantity of even low-grade ore here, though the conditions are not unfavourable for deposition.

No. 4 (M.F. 4).

LOCATION, ETC.

Freehold No. 4 lies 2 miles east-north-east of the township.

Its area is 80 ac. It is held by the Queensland Exploration Company.

No ore-bodies have been found on this freehold.

No. 3 (M.F. 3).

LOCATION, ETC.

Freehold No. 3 is 2½ miles east-south-east of the township.

Its area is 80 ac. The Queensland Exploration Company now holds the freehold.

An unsuccessful search was made for the old workings here, which comprise, it is believed, two shafts.

ORE-BODIES.

The only ore seen was hæmatite and a little dense limonite. The main crop, which runs north and south along the summit of a ridge, is several chains long, and in one place is probably 40 ft. wide. No copper ore was seen, but other iron-bearing crops are visible on a line to the east of the northern end of the main crop.

It is unlikely that any considerable **body of copper ore is to be found here.**

Lady Mina (M.L. 552).

Mgr., Miller.

LOCATION, ETC.

The Lady Mina is 30 ch. south-east of M.F. 3 and 3 miles east of the township.

Its area is 5 ac. This is understood to be the property of the firm of Graham and Matheson.

DEVELOPMENT.

The workings comprise a shaft 56 ft. deep (Jan., 1907), and an opencut running 35 ft. to the north-west from the shaft, which is in the southern corner of the lease.

OUTPUT.

1906 ... 3 tons.

ORE-BODIES.

In the opencut can be seen a well defined footwall, dipping about 75° to the north-east, but all ore has been removed. The ore can be traced on the surface for 20 ft. south-east of the shaft.

Both cut and shaft have proved a formation, averaging 2 ft. in width, in which copper ore (malachite and chalcocite) occurs as irregularly shaped masses, and quartz as sheets on the footwall. Sulphides were reported in the Press to have been struck in May, 1907.

There are 5 tons of ore bagged, besides 4 tons of firsts (40% copper) and 1½ ton of seconds (25%) paddocked. The rejected, very siliceous, thirds amount to only 2 tons.

Mata (M.L. 692).

Mgr., Willmer.

LOCATION, ETC.

The Mata, embracing the Little Duchess, adjoins the A1 freehold on the east. It is about 1 mile from the Cloncurry post office.

Its area is 24 ac.

OUTPUT.

1904 ... 7 tons shipped, carrying 31% copper.
7 ,, ,,

No. 2 (M.F. 2).

LOCATION, ETC.

Freehold No. 2 adjoins the A1 freehold at the south-western corner, and is traversed by the main anabranch of the Cloncurry River.

Its area is 160 ac.

It is held by the Queensland Exploration Company.

ORE-BODIES.

The ground has been secured presumably to catch the continuation of the Contra lode of the A1 freehold, but, being covered by sandy alluvium, no outcrops have been found.

No. 19 (M.F. 19).

LOCATION, ETC.

The second Freehold No. 19 is located on the anabranch of the Cloncurry River at the south-western corner of the township.

Its area is 19 ac.

ORE-BODIES.

The holding, which was not inspected, is on the flood plan of the Cloncurry, and no outcrops were expected, but the company's plan shows a short one running north-north-eastwards. The manager reported in July, 1907, that this crop had been exposed over a distance of 262 ft., and proved to be about 6 in. wide; later he sank a shaft 16 ft., the vein, consisting of "bornite and chalcopyrite, in a specular iron matrix," being about 5 in. wide in a formation 2 ft. wide.

No. 10 (M.F. 10).

LOCATION, ETC.

Freehold No. 10 is situated at the junction of Chinaman Creek with the Cloncurry River, and is 1½ mile west-south-west of the township.

Its area is 125 ac. The freehold is now the property of the Queensland Exploration Company.

ORE-BODIES.

The freehold lies to the east of the main mass of Mount Leviathan, but includes the north-eastern extremity of the iron ore deposit.

The company's plans indicate a small east and west "outcrop of peacock copper" on the eastern side, which, however, was not seen by me. This crop has been sunk on since my visit. At a depth of 25 ft., "the ore-body has opened out to about 3 ft. . . . with 5 in. of good ore on one side and 8 in. on the other. This would average about 20 per cent. copper." In September, at 34 ft. depth, the formation occupied the whole width of the shaft, there being 6 in. of good ore on each side. At about 40 ft. depth much water was struck. The shaft at 37 ft. below the surface shows 2 ft. of 20% ore at the northern end, and 8 in. at the southern. Drives were carried northwards on 6 to 18 in. good ore in a 4-ft. formation and southwards in poor formation.

MORRIS CREEK.

The ore-bodies here examined trend generally east and west, as at Duck Creek, in contradistinction to those of the rest of the field, which run north and south. The crushing of the country, however, has been far less intense than at Duck Creek.

SERPENT HILL GROUP.

This group comprises the five contiguous freeholds—Nos. 5, 6, 7, 8, and 9—lying 6 miles west-south-west of Cloncurry.

The holdings were deserted at the time of my visit, and, there being some doubt as to their exact location, no attempt was made by me to find them. They have since been re-marked, and have now passed into the hands of the Queensland Exploration Company.

The freeholds are each 160 ac. in extent, and they lie on a north-west and south-east line, being in contact only at opposite corners.

Nos. 5, 6, and 8 are reported to include no outcrops. Mr. Rutherford remarks, "It is difficult to understand why such a large area—800 acres—was taken up in this district. . . . as I failed to see any indications that payable ore would be found on these freeholds."

Serpent Hill No. 7 (M.F. 7).

LOCATION, ETC.

No. 7 is at the south-eastern extremity of the group, and lies 4½ miles south-west of Cloncurry.

Its area is 160 ac.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford has written—

> No. 7, the most southern of the group, encloses a siliceous limestone prominence 200 ft. long and 40 ft. high. This limestone is stained with carbonate, and carries some nodules of red oxide of copper associated with iron. Immediately beyond the limestone to the north, lying in flat country, is a band of vitreous ferruginous quartzite. Two trenches across this band both show ferruginous quartzite.

Serpent Hill No. 9 (M.F. 9).

LOCATION, ETC.

No. 9 is at the north-western end of the line of freeholds, and is 5½ miles west of Cloncurry.

Its area is 160 ac.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford wrote of No. 9—

> This is taken up to include a quartzite hill, which gives its name to the group. Several shallow trenches have been cut in an erratic manner at the base of the hill in barren rock. The summit of the hill, however, is in places freely stained with carbonate. A trench 20 ft. long across the strata shows that these stains are confined to the surface. Some good boulders of malachite have been shed from the hill, and can be picked up on the surface.

Chum (M.C. 329).

Mgr., Davis.

LOCATION, ETC.

The Chum is 7 miles west-north-west from Mount Leviathan and 2 miles east from Butcher's Creek. There has been some doubt as to whether this lease is located on a freehold.

Its area is 600 ft. × 350 ft. It was exempt when visited.

DEVELOPMENT.

The workings comprise only one shaft, 15 ft. deep (10 ft. long and 6 ft. wide), and two potholes, 5 and 4 ft. deep respectively, 10 and 20 ft. east of the shaft. No work has been done here for some time .

OUTPUT.

1906 ... 3½ tons of ore shipped.

ORE-BODY.

The country here is stratified quartzite, and little can be made out as to the strike of the deposits. In the shaft the body appears to strike north-north-east dipping easterly, but the potholes are on an east-by-south line, and in the first cupriferous gossan is exposed, while in the second gossan can also be seen. A small patch of oxides crops 1½ ch. west of the shaft. These, however, appear to be separate patches, and a chain to the east only iron-stained quartzites, similar to the country to the south, can be seen. The quartzites crop within 30 ft. south of the shaft, and the lode can therefore have no extent in this direction, while it is likely to prove bunchy in form.

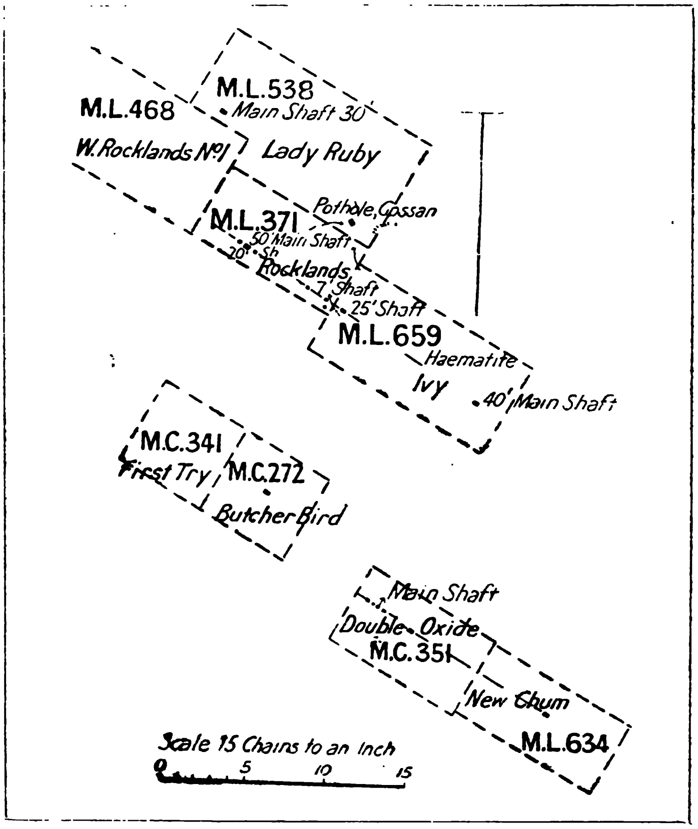
Over the whole length of the shaft masses of gossan and bunches of chalcocite-limonite ore, both with malachite and the former with some cuprite, occur between horses of country rock. Barren rock, cupriferous and ferruginous clay, and ore (varying between 10% and 40%, but averaging 20% copper) may be taken as present in equal quantities—the northern side of the shaft being rather poorer in copper, though richer in iron, than the southern. The western end of the shaft shows a face—perhaps a wall of the lode—dipping 10 in 1 to the east.

About 3 tons of lump ore, as raised from the shaft and lying at the brace, consists of siliceous limonite with tile ore and malachite, and may run 20% copper. The appearance of this ore is promising for the finding of richer ore beneath. The 1½ ton of firsts near the shaft comprise siliceous limonite, tile ore, crystalline cuprite in banded aggregates, acicular malachite, and dense chalcocite, and should contain at least 20% copper—the percentage depending chiefly on the composition of the tile ore. Besides this there are 6 tons bagged on the ground.

Thus, no continuous body of ore has been proved here, but the outcrops should receive thorough prospecting.

ROCKLANDS GROUP.

This group lies between Butcher's and Morris Creeks, 9 miles west of Cloncurry. Little work was going on here at the end of last year.



Double Oxide (M.C. 351).

Mgr., Neal.

LOCATION, ETC.

The Double Oxide is 9 miles west-by-north of Cloncurry in open rolling gidia country.

Its area is 600 ft. × 350 ft.; and it includes the Magpie and Oxide claims.

Idle when visited.

DEVELOPMENT.

Besides a few potholes, there are here four shafts. The main underlie shaft (5 in 1), 2 ch. from the western boundary, is 25 ft. deep, and the ground has been stoped out from it for 10 ft. to the east. A new shaft, 20 ft. to the east of this, is 20 ft. deep. The third, 15 ft deep, is 2 ch. to the east-south-east.

OUTPUT.

1904	... 8	tons	(Magpie)
1906	... 12½	,,	(Oxide)
—	... 8	,,	(Roberts and party)
Total	... 28½	,,	

ORE-BODIES.

The New Chum line, which appears to be parallel to and about 10 ft. south of the Oxide, can be traced along the surface by crops of quartz and gossan.

Very little ore can have been raised from the eastern shaft, which is on the above line.

The Oxide, striking east 20° south, makes little show at the surface, but at the main shaft a formation—altered schist—rich in copper in parts but averaging only 10% in the present face, has been exposed over a width of 4 ft., and no hanging-wall has yet been reached. The formation pinches to 2 ft. 6 in. in the eastern end of the stope, and the average content there is 15% copper. Flat clay floors, some of them 6 in. thick, cross the formation at intervals of from 6 in. to 2 ft. Malachite is the chief copper mineral in the limonite, but chrysocolla is more abundant in the altered schist. The firsts at grass, amounting to 5 tons, are rather siliceous limonite with veins and bunches of cuprite; and some 16 tons have been shipped from here. The mullock tip should carry at least 5% copper.

The country rock at the second shaft is a quartz-veined argillaceous quartzite, but the ore here carries little quartz. The 10 tons of ore at the brace have not yet been sorted. It is chiefly limonite containing malachite, chrysocolla, and cuprite, and carrying about 10% copper.

New Chum (M.L. 634).

Mgr., Davis.

LOCATION, ETC.

The New Chum adjoins the Double Oxide on the east.

Its area is 5 ac.

The only excavations beyond a few shallow trenches is the shaft, 20 ft. deep, near the centre of the claim.

ORE-BODY.

The ore-body can be traced westwards to the eastern shaft in the adjoining claim, the line being parallel to, but about 10 ft. south of, the main Double Oxide line.

The shaft was sunk in thin bedded slates, with bunches of silicified limonite; and there is at grass about 1 cwt of quartz-bearing limonite, containing a fair proportion of cuprite. The cuprite is crystalline, and in most unsymmetrical forms, but is evenly, if thinly, coated with vitreous greenish chrysocolla. This ore has some resemblance to that at the Great Australia.

Butcher Bird (M.C. 272).

Mgr., Roberts.

Location, Etc.

The Butcher Bird shaft lies about 10 ch. west 35° north of the Double Oxide.

Its area is 600 × 350 ft.

One shaft, 14 ft. deep, and a pothole, 7 ft. deep, are all the workings.

Output.

1905 ... 8 tons.

Ore-body.

The shaft has been sunk in rotten formation—ferruginous kaolin with lumps of limonite, showing some malachite towards the bottom. Nothing definite has yet been proved here, but sinking should be continued.

This does not seem to be a continuation of the Double Oxide as its strike (east-south-east) would carry it to the north of the main workings on the latter.

The pothole to the north-west of the shaft is in iron-stained quartz not worth further testing.

First Try (Extended M.C. 341).

Mgr., Melhouse.

Location, Etc.

The First Try adjoins the Butcher Bird on the west.

Its area is 400 × 350 ft.

Only four potholes have been opened here, the deepest 4 ft. down. No lode has yet been found.

Cherry (M.L. 670).

Mgr., Connell.

Location, Etc.

The Cherry is 1½ mile south of the Rocklands.

It area is 10 ac. It was not inspected by me.

Mount Abundance (M.L. ?).

Mgr., Connell.

Location, Etc.

Mount Abundance is 7 miles west of Cloncurry.

Its area is 10 ac. It was not inspected.

Output.

1906 ... $\frac{14}{20}$ ton.

Rocklands (M.L. 371).

Mgr., Hockings.

LOCATION, ETC.

The Rocklands is less than ½ mile south-east of Morris Creek, and 9½ miles west-by-north from Cloncurry, the distance by road being 10 miles.

Its area is 5 ac. The lease was exempt when inspected at the end of 1906, and the mine had been idle for some time.

DEVELOPMENT.

The workings run nearly the whole length of the lease, but are all shallow. The eastern shaft (*a*), 10 ft. deep, is ½ ch. from the south-eastern corner; 5 ft. west of it is a trench, 10 ft. long; 1 ch. beyond is a shaft (*b*), 7 ft. deep. Then 4 ch. further west is a shaft (*c*), 20 ft. deep (flooded); ½ ch. beyond is another (*d*), 15 ft. deep (filled in), at which some stoping has been done; and 10 ft. further west is the main shaft (*e*), 50 ft. deep (inaccessible). A filled-in trench lies 10 ft. west of the main shaft, and 15 ft. beyond it is another shaft (*f*) 15 ft. deep.

OUTPUT.

1906	... 22½ tons.

ORE-BODIES.

The line of strike is west 32° north, and the dip is 5 in 1 northwards, as shown by the workings. The country rock is a black slate weathering to a brown tint and bleached almost white near the ore-body, especially in the western shafts. Very little can be seen of the ore-body, which, however, can nowhere have exceeded 2 ft. in thickness. Practically all rich ore raised has been shipped, and it cannot be said, without further development, that there is any in sight.

A few hundredweights of very siliceous fine-grained carbonate ore (25% copper) is at grass at shaft (*a*); and at shaft (*b*) there are a few pounds of carbonate and oxide ore. Only a small heap of seconds—country carrying 1% copper—now remains at shaft (*c*).

At the main shaft (*e*) there are now only 2 cwt. of firsts (30% copper) at grass—chalcocite with malachite stains and coated with kaolin. The cellular gossany seconds at grass amount to 10 tons, and should average 5%.

In the western shaft (*f*) the formation near the surface is 1 ft. wide, and a bunch of rich ore was gouged out here.

Rocklands No. 1 East (M.L. 659).

Mgr., Lyons.

LOCATION, ETC.

This, which is also known as the Ivy, adjoins Rocklands on the east.

Its area is 8 ac. Exempt when inspected.

DEVELOPMENT.

The main shaft at the eastern end of the lease is 40 ft. deep; and water is now standing at about 35 ft. below the surface. A stope runs back 10 ft. on the northern side of the shaft.

Another shaft, 25 ft. deep, and a cutting are on the north-western boundary.

OUTPUT.

	18 tons	(western workings)
	3 ,,	
	3 ,,	rubbly surface 28½%
	7 ,,	no returns to hand
Total ...	31 ,,	

ORE-BODIES.

The western shaft and cutting are on the Rocklands line. The country is softened slate, and the ore, striking east 35° south, crops as silicified limonite, with malachite and tile ore. One bunch here yielded 18 tons of pay ore.

Some dense hæmatite indicative of regional metamorphism crops on the line of strike between these workings and the main shaft.

In the main shaft a formation, 3 ft. wide, of malachite-stained softened slate with siliceous cellular gossan, dipping steeply northwards, has been struck. The gossan is a promising feature, as far as improvement in depth is concerned. The hanging-wall country is much slickensided internally owing to lateral crushing, as proved by the horizontal striæ. The ore at grass, 4 tons, is chiefly earthy carbonate with traces of glance and rather much quartz, but is expected to yield 30% copper.

Rocklands No. 1 West (M.L. 468).

Mgr., Hockings.

LOCATION, ETC.

This adjoins the Rocklands on the west.

Its area is 10 ac. The ground was deserted in December, 1906, and was not inspected, as no work had been done.

Lady Ruby (M.L. 538).

Mgr., McCall.

LOCATION, ETC.

The Lady Ruby adjoins the Rocklands and Rocklands No. 1 West on the north.

Its area is 10 ac. Exempt and deserted.

A pothole in the southern corner and an inaccessible shaft, 30 ft. deep, in the western corner, are the only workings.

ORE-BODIES.

The southern pothole is on gossan, but has not yet struck ore.

The main shaft is sunk just to the south of a quartzite crop in decomposed slates dipping northwards about 4 in 1.

The only ore at the shaft is about 1 cwt. of copper-stained country rock, in which can be seen small seams and beads of cuprite.

Nothing is visible here to warrant further work.

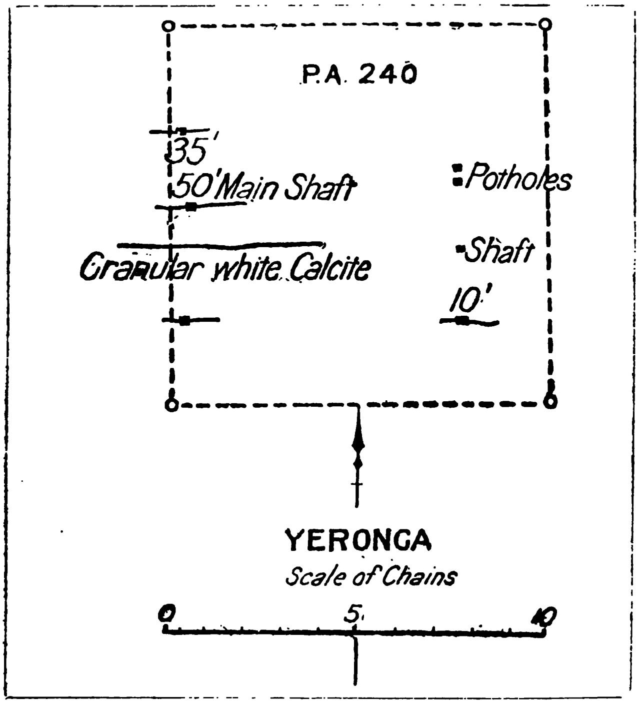
Yeronga (P.A. 240).

Mgr., Hockings.

LOCATION, ETC.

The Yeronga is ¾ mile north-west of the Rocklands, ¼ mile over Morris Creek.

Its area is 10 ac.



DEVELOPMENT.

The main shaft, 50 ft. deep, with 8 ft. standing water, is near the middle of the western boundary, has a stope running back for 10 ft. to the east, and drives 12 ft. east and west at the bottom and 20 ft. depth respectively; a second shaft, 35 ft. deep, lies 2 ch. to the north (inaccessible); a third lies 7 ch. to the east; and a fourth, 10 ft. deep, 7 ch. to the east-south-east.

OUTPUT.

Total of 30 tons shipped averaging 34% copper.
5 ,, 27% ,,
—
35 ,,

ORE-BODIES.

There are here at least three east and west striking lines, besides which, a chain south of the main shaft, is a defined crop of granular white calcite. Earthy calcareous sinter, derived from the country rock, is also very abundant in all the ore raised here. The occurrence in the main shaft is promising, but no quantity of ore has yet been proved.

The ore-body, in which is the main shaft, dips 10 in 1 to the south. It is 1 ft. wide at the surface, but, in the western drive, there is quite 2 ft. of limonite and very calcareous ore. The country there is softened slate, without sign of movement. The ore at grass, about 1 ton, is limonite with much chalcopyrite, considerable malachite, and some chrysocolla.

The south-eastern shaft is in decomposed calcareous slate, in which a little ore has been got. Fragments of ore can also be got along the line of strike, and about 7 ch. to the west was found a patch which yielded 3 tons of 33% ore—chalcopyrite and chalcocite.

The northern shaft is in very limy decomposed country, in which the ore occurs as boulders near the surface, but at the bottom there is a defined formation 3 ft. wide. The seconds, about 1 ton, are limonite with chalcopyrite, pyrite, chrysocolla, and carbonates. Some quartz cemented by limonite, jasperoid, and chalcopyrite is coming in in the shaft bottom. The firsts, of which 5 tons, assaying 27% copper, have been shipped, are reported to have contained some good cuprite.

The eastern shaft and potholes are in gossany copper-stained country.

Fairfield (M.L. 680).

Mgr., Hockings.

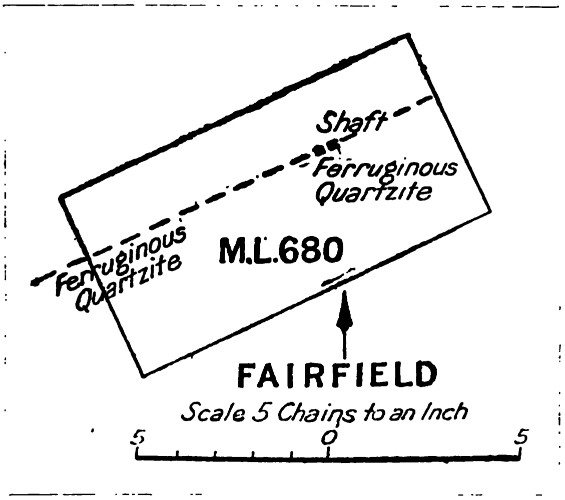
LOCATION, ETC.

The Fairfield lies 1½ mile north-north-west of the Rocklands, and 10 miles west-north-west of Cloncurry.

Its area is 5 ac. The lease was deserted at time of inspection. This ground was formerly held as the Waimakaori, and as the Darra.

DEVELOPMENT.

The old eastern shaft (*a*), 10 ft. deep and flooded, is 3 ch. south-west of the northern corner of the lease; another old shaft, 25 ft. deep underlying 10 in 1 to the south, lies 30 ft. to the west; and the shaft, 15 ft. deep, is 30 ft. south-west of this.



OUTPUT.

2 tons shipped 32% copper.
3 ,,

ORE-BODIES.

The Fairfield crop at the new shaft is 10 ft. wide, and consists of silicified limonite and gossan. It pinches out about 20 ft. west of the shaft, but crops again in several places beyond. Eastwards also it thins out, but there is here a band of gossan on the northern side, in which the old shafts were sunk. The crop strikes east-north-east, and the dip is to the south-south-east.

The two old shafts appear to be on one shoot, of which the silicified limonite forms the hanging-wall. In the shaft (*b*) a formation, 1 to 2 ft. wide, carrying bunches of ore, is exposed.

The new shaft is being sunk in kaolinised slate above the silicified limonite. A nearly vertical lens of ore was met in this shaft, and there is now paddocked about 2 tons of siliceous chalcocite-malachite ore expected to yield 30% copper.

Nothing of any value has yet been exposed here, but there is a possibility of the silicified limonite blows overlying sulphides, and the amount of silica may decrease with depth.

Unnamed (M.F. 16).

LOCATION, ETC.

This freehold is south of Morris Creek, 9 miles west-south-west of Cloncurry.

Its area is 160 ac. Not inspected.

CAMERON RIVER.

The Cameron River mines are of relatively little importance. The Federal is included here, as is the usual custom, though it is really within the Corella drainage area. Numbers of claims have been, or are, in existence on the northern side of the Cameron Valley, but their location had not been sufficiently fixed for a visit to be paid to them.

MOUNT LLOYD GROUP.

The Mount Lloyd Group is located in the valley of the Cameron River. It comprises, besides those described below, the Mount Lloyd No. 1 North (M.L. 497), Mount Lloyd No. 2 South (M.L. 517), and Mount Lloyd No. 3 South (M.L. 545), on which no work has been done, and the Saint Patrick (M.L. 498), in the southern part of which is a shaft, not seen by me.

Mount Lloyd (M.L. 446).

Mgr., Thompson.

Location, Etc.

Mount Lloyd lies 31 miles west of Cloncurry and about 2 miles south-east of the West Leichhardt telegraph line.

The leases are on a north-north-west running razor-back near the centre of a wide flat-bottomed valley, bounded by a rounded range to the west and a fairly-level topped range to the east.

Its area is 30 ac. It is understood to have now been abandoned, the exploratory work having been carried out under option by the North Queensland Exploration Company.

Development.

An opencut 25 ft. long, 10 ft. wide, and 7 ft. deep, has been made on the ridgetop near the centre of the lease. In the trench is a shaft 50 ft. deep, from which the upper ladders had been removed, rendering it inaccessible. Several other small trenches have been made to the south-east, along the hillside.

Ore-bodies.

A crop of quartzite runs north-north-westwards along the crown of the ridge and dips steeply west-south-westwards. It has been proved by the cut to carry not 1% of copper and very little iron oxide —even in the richest part. The tip at the shaft proves that the sinking was in silicified schist with stains of malachite in places.

Mount Lloyd No. 1 South (M.L. 499).

Location, Etc.

This adjoins the Mount Lloyd on the south.

Its area is 5 ac.

Two cuts have been opened on this lease, about ¼ mile south-south-east of the Mount Lloyd shaft.

Ore-bodies.

The cuts expose only small bunches of ore in quartzite.

EUSTON GROUP.

This group is on the lower portion of the Cameron River, near the bottom crossing of the West Leichhardt telegraph line.

Cameronian (M.C. 196).

Mgr., St. Onge.

LOCATION, ETC.

The Cameronian lies 27 miles west-north-west of Cloncurry, and about a mile north-west of the West Leichhardt telegraph line.

Its area is 400 ft. by 350 ft.

One hole has been sunk 7 ft.

OUTPUT.

Several tons of ore are reported to have been shipped.

ORE-BODIES.

Bunches of cupriferous gossan are found to occur in slates over a width of 30 ft., at the southern end of a low ridge. The hole is on a copper-bearing lenticular body 2 ft. to 2 ft. 6 in. wide, which can be traced for about a chain to the north-east. There are at grass a few hundredweights of seconds, consisting of quartz-bearing limonite, with some chalcopyrite, chrysocolla, and malachite.

Unnamed (M.C.).

Mgr., Lidster.

LOCATION, ETC.

This is about ¾ mile north of the Cameronian.

A pothole, just begun, was 4 ft. deep when visited.

ORE-BODIES.

The pothole is in earthy limestone and sintry slates containing bunches of limonite-malachite-chalcopyrite ore. About 1 ton of ore is paddocked, and consists in great part of limonite, with original chalcopyrite and stains and coatings of malachite. It is likely to yield 20% copper.

FEDERAL GROUP.

The group comprises only one lease.

Federal (R.C. 52).

Mgr., Brassington.

LOCATION, ETC.

The Federal lies 20 miles west-north-west of Cloncurry. The Argylla road passes the mine, about 3 miles west of the Corella River.

The country here is open and rolling with gravelly red soil, timbered sparsely with mountain gum and clothed with spinifex.

Its area is 80 ac. The mine was deserted when visited by me, but has since been taken over by the Federal Reward Copper Company, Limited.

DEVELOPMENT.

The main workings appeared to have been deserted for some time, and most of them have collapsed. They comprise, beginning at the southern end: an open cut (*a*), 35 ft. long and 15 ft. wide, now full of water; a trench (*b*), 10 ft. long, 10 ft. to the north of the cut; two potholes (*c* and *d*), 5 ft. deep and 15 ft. apart, 35 and 50 ft. north of the last; a filled-in cut (*e*), 10 ft. long, 20 ft. beyond; a flooded trench (*f*), 10 ft. long, with a 10-ft. hole at one end, 5 ft. to the north; and a main shaft (*g*), 30 ft. deep, with open cuts or fallen-in stopes for 15 ft. north and 10 ft. south at 15 ft. beyond the last. At 5 ch. north-north-east of the main shaft is the shaft (*h*) last worked, which is about 15 ft. deep; and about 1½ ch. to the south-east of it are a few shallow trenches.

OUTPUT.

1904	... 85	tons shipped.
1905	... 71	,, ,,
1906	... 12	,, ,,
	... 12	,, ,, *
Total	... 180	,, ,,

ORE-BODIES.

The southernmost cut (*a*), being full of water, reveals little. There are about 5 tons of seconds alongside it—siliceous ore containing malachite and nodular radiating azurite, and likely to run over 15% copper. The whole of the mullock tip should yield at least 1% copper.

In the northern end of the trench (*b*) can be seen 18 in. of cupriferous quartzite and formation. The 1 ton of firsts (quartz and malachite) at grass probably carries 20% copper; and the ½ ton of seconds may yield 10% copper.

The first of the potholes is on the western side of a quartzite crop.

The cut (*e*) is on a slight bend in the quartzite crop.

The whole formation in the main shaft and stopes probably averaged 12 to 18 in. in width, but at the northern end the ore occurs simply as stainings on joints in the slates, but presumably bunches have been found by following these joints, and there is indication of one in the footwall. Dog-tooth quartz is plentiful, and some fairly rich fine-grained malachite, nodular azurite, and limonite with disseminated malachite, are to be seen here.

The firsts, of which there were 2 tons at grass, are very siliceous, encrusted by malachite and contain nodules of azurite. The seconds at grass amount to 4 tons; they are very siliceous, but are gossany and carry perhaps 5% copper chiefly as carbonate. Further there are about 4 tons of unpicked ore paddocked, consisting of limonite with disseminated malachite and bunches of azurite, which must have come from bodies up to 12 in. in width.

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* By Hockings and Brassington; source doubtful.

The country rock is kaolinised schistose slate passing near the lode into greenish chloritic schist, in which the ore-bodies occur on a general north and south line, dipping about 5 in 1 to the west.

The new shaft (*h*) is on a 2-ft. band of country (slaty schist with north and south strike), carrying malachite and azurite. The strike is north and south and the dip is steep to the west. There was 1 cwt. of firsts (limonite with traces of chalcopyrite and rich in malachite and azurite) of 30% copper grade; and a few hundredweights of 20% seconds, at grass.

The easternmost trenches prove only that the schistosity of the country here trends north-eastwards.

The workings have been too long idle for much to be learnt as to the nature of the ore-bodies, further than that they are composite lodes—with comparatively small linear extent. The indications warrant further opening up to test whether an improvement takes place in depth.

ARGYLLA CREEK.

The Princess East, South, and North are three leases (Nos. 594, 593 and 592), each 10 ac. in area, of which no particulars are to hand, beyond that they lie 3½ miles south-east of the Argylla freehold. The Megaphone, a lease (No. 541) of 10 ac. is understood to lie 3 miles south of the freehold.

ARGYLLA GROUP.

The group comprises a freehold and a few leases in its vicinity. The Argylla North (M.L. 539), West (M.L. 536), and South (M.L. 540), after being abandoned, were taken up again by the West Cloncurry Copper Company, Limited, in areas of 20 ac. adjoining the freehold.

Argylla (M.F. 3073).

Location, Etc.

The freehold is situated on the eastern side of a branch of the Argylla valley, 13 miles east of the West Leichhardt Telegraph Station and 40 miles west of Cloncurry.

Its area is 40 ac. The Argylla is now held by the Queensland Copper Freeholds, Limited. My visit was made with the assistance of and in company with, the Warden (Mr. Linedale), on whose account the examination had to be very hurriedly performed. From what was seen, however, it was not considered worth while to revisit the locality even if it had been possible without considerable expense, more especially as the ground was deserted.

Literature.

(2) Mr. Jack's report is as follows:

> The Argylla Mine is a wide belt of copper-bearing country running north-north-west to south-south-east. The dominant feature of the belt is a wide reef of rather open and friable quartz, standing up as a crest on a hill top for about three-eighths of a mile, and nearly 80 ft. above the general level of the slate country.
>
> The western side of the quartz reef at its north end is stained with carbonate of copper, its numerous caverns being conspicuous from a long distance owing to their bright green colouring. Traced to the south the whole is seen to be a belt of copper lodes, generally running parallel to the dominant quartz reef, but sometimes running out obliquely from it, and abutting against parallel veins of quartz. We saw a good deal of green carbonate of copper, often radiated and fibrous, and of the highest possible percentage. We could also knock out or pick up on the hill side, or in the gullies, heavy boulders of red oxide of copper and grey ore.
>
> The Argylla property will take a large sum of money to explore. No company without very considerable capital should, in my opinion, attempt the task, but I believe the expenditure would be richly repaid. The green-painted caves in the quartz, I have no doubt at all, represent great bunches of ore which have been denuded. . . .

(4) To the above Mr. Cameron added:

> Since Mr. Jack's visit some little attempt has been made to investigate the resources of the lode. Two cuttings towards the southern end of the outcrop, and some 150 paces apart, have been put in in the western side of the hill. They expose first talc schists and then about 5 ft. of a weathered sandy rock impregnated with copper glance and carbonate in irregular patches and veins.

An average sample of the portion of the lode exposed gave 15·95 per cent. copper, a trace of gold, and 2 dwt. 22 gr. of silver per ton from the northern cutting, and 35·2 per cent. of copper, a trace of gold, and 9 dwt. 2 gr. of silver per ton from the southern cutting. An irregular trench on the summit of the outcrop, some 70 ft. east-north-east of the southern cutting, is about 6 ft. deep and 6 ft. across, and goes east for 20 ft., and then north for about 18 ft. It exposes decomposed talcose and sandy schists with scattered veins of quartz and carbonate ores running through it. About 10 or 12 tons of picked ore are lying in the trench. An average sample taken from this picked ore gave a return of 20·75 per cent. of copper, a trace of gold, and 4 oz. 2 dwt. 8 gr. of silver per ton. To all appearances the Argylla Outcrop should be able to furnish a considerable quantity of ore of a value quite equal to that found in the trench on the summit, and the cuttings into the walls. The working of the lode would no doubt mean the removal of a great quantity of valueless material, but the ore would be easily picked from the gangue, and according to the assays of a very good percentage. The extent and value of the copper-bearing belt could be comparatively easily proved by surface trenching along the line of strike of the lode.

(7) Mr. Rutherford's description is as below:

This includes a succession of parallel beds of altered sandstone lying on schist forming a range running north-west and south-east for 2,000 ft. and rising to a height of 80 ft. above the general level. The rock is coloured a bright green in places with copper carbonate. This staining is very patchy, and is most pronounced in joints and in natural caves in the rock. In places small seams of red oxide and glance are seen. . . .

Following the outcrop to the north it ends in barren, tough quartzite, and at its southern extremity it ends abruptly, and does not outcrop anywhere down the side of a steep schist hill.

This belt of country, which is similar to many others seen in the district, contains a few seams of rich glance and red oxide scattered in a detached irregular manner through the formation. Due to the enormous amount of dead work which would have to be done to mine any of this ore, I consider that it would be an unprofitable undertaking.

(1) Mr. Linedale in a report dated 31st October, 1907, states:[1]

A few days ago I paid a flying visit to the Argylla Freehold. The West Cloncurry Copper Company, Limited, has closed down all its mines in this locality, but the Freehold is still being prospected. In the latter property, No. 1 shaft is down a depth of 100 ft., and crosscuts at that level have been extended north-east and south-west. The south-west cut has penetrated a distance of 100 ft., the first 30 ft. being through a formation carrying bunches of quartz and nodules of limonite and oxidised copper ores. The north-east cut is in 130 ft., the first 40 ft. of which pass through a formation carrying a little copper, and from thence to within a few feet of the face a body of schist, slightly impregnated with copper, was passed through. The face of the cut is now in a formation of crushed quartz, showing stains of copper carbonates. No. 2 shaft was sunk to a depth of 100 ft., and crosscuts extended north-easterly and south-westerly 40 ft. and 100 ft. respectively. The former cut passes through bars of diorite and quartzite carrying a little copper sulphides, and the latter for some distance is through a formation of quartzite and limonite impregnated with carbonate of copper. The end of this cut is in micaceous schist.

DEVELOPMENT.

Four cuts have been opened on this property. The northernmost (not seen by me) is stated to be 30 ft. long. At 7 ch. to the south is a costean 25 ft. long and 6 ft. deep. The third cut, 1 ch. to the north-east of and 30 ft. above the last mentioned, is 7 ft. deep and runs 15 ft. south-west and then 15 ft. west. The fourth cut (not seen by me) is said to be 9 ft. long and to be just above the third.

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[1] Q.G.M.J. Nov. 1907.

ORE-BODIES.

Only two ore-bodies were seen by me. That at the southern trench comprises kaolinised slates dipping about 80° to the west-south-west and impregnated and replaced to varying extents, over a width of 4 to 5 ft., by cuprite, round which mineral the kaolin is considerably stained by malachite. The crop, consisting of kaolinised slate variously veined and impregnated with malachite, is traceable for 40 ft. to the south-south-west of the trench. This may be expected to yield some rich ore.

The main ore-body, at the upper trenches is U-shaped, the U being 1½ ch. in length and 40 ft. across, with the open end towards the south-east. The south-western arm consists of crushed carbonate veined quartzite, 6 ft. wide and passing into "silicified limonite" and then into quartzite towards the end. This is low-grade at the best. The northern arm is 15 ft. in width in one place but the trench exposes only kaolinised slates with bunches of mixed tile ore and malachite bearing ore. The cut would seem to indicate that concentration of carbonates has taken place near the surface owing to kaolinisation of the rock there, and the prospects of meeting a large ore-body by sinking are therefore not very bright. Some tons of a very siliceous ore, rich in crystalline malachite, are stacked here.

The crest of the Argylla ridge is of a siliceous rock—presumably silicified slate—but, Mr. Conder's sections, to which reference has previously been made, prove that certain of the dark-coloured rocks in the vicinity are altered diorites.

Advance (M.C. 338).

Mgr., Canlons.

LOCATION, ETC.

The Advance lies 3 miles south-east of the Argylla.

Its area is 800 ft. × 350 ft.

Three shallow holes have been opened.

OUTPUT.

12 tons shipped.

ORE-BODIES.

The ore-bodies comprise small bunches of rich ore (carbonate and oxide) with limonite in quartz. The country rock is a hornblendic rock producing a soil rich in calcareous sinter.

PALM-TREE.

A number of ore-bodies, among which may be mentioned the Cleanskin and Little King, have been worked at various times in the ranges at the head of Palm-tree Creek. The miners, however, have no confidence in their permanence, and, even in the vicinity of the Native Companion, several have not considered it worth while to register their claims.

In addition to those mentioned below, the plan accompanying Mr. Cameron's report shows a lease called Mount Bracewell, adjoining the Enfield on the north, and another called the South Mullen, lying 1½ mile to the north-west. No important ore-bodies were found on them, and they have now been abandoned.

NATIVE COMPANION GROUP.

Small crops of copper ore in schist are numerous in the vicinity of the Native Companion, and for at least 2 miles to the north, but except on the reward claim very little work has been done. The shoots at the surface are very short, but may possibly prove more extensive at a depth.

Native Companion (R.C. 19).

LOCATION, ETC.

The Native Companion is located on the north-western side of Palm-tree Creek, 7 miles south-south-west of Quamby, on the Camooweal road, and 26½ miles north-west of Cloncurry.

Its area is 160 ac. The property is held by the Leichhardt-Cloncurry Company.

DEVELOPMENT.

The main shaft, which is in the south-western corner of the lease, 10 ch. from the boundary peg, is 34 ft. deep, and has drives running 12 ft. to the south-west and several feet to the north-east at the 25-ft. level, which is just above water. Work ceased here because of a heavy influx of water, probably from the creek, which is 7 ch. distant. It is now proposed to install a pump. At 6 ch. to the north-east of the above there is an opencut and old shaft, caved in below a depth of 15 ft., but from which at the 30-ft. level a drive ran 50 ft. to the south-west. Another old shaft, 15 ft. deep, lies 1 ch. to the north-north-east of the last, and from this also there was a drive southwards.

The other workings comprise costeans at ½ ch., 2 ch. and 4 ch. north-east of the main shaft, a pothole alongside the Quamby track, near the northern boundary, and a costean on the bank of Palm-tree Creek, 4 ch. south-east of the last. One man was at work here on costean No. 3, at the end of the year 1906.

OUTPUT.

1904 ...	...	33	tons shipped, carrying 49 to 52 % copper.
1905 ...	...	$40\frac{13}{20}$	,, ,,
Total	...	$73\frac{13}{20}$	,, ,,

ORE-BODIES.

Two small shoots of payable ore have been located on a north-east and south-west line and, though small near the surface, further prospecting to test whether they increase in size at a depth is fully warranted.

Ore is stated to have been found at the surface on the site of the main shaft, though there is no trace of it to the south-west. In the shaft the ore-body had a width of 2 ft. 6 in. from wall to wall, but it pinched out in the drives, the face of the eastern showing only kaolinised micaceous schist country, with flat bunches of chalcopyrite, but no defined body. There is, however, a likelihood of further bodies being picked up, if the drive is continued. Nearly 50 tons of ore have been shipped from this shaft. The tip consists of crystallised quartz and kaolin with a little chrysocolla, and the whole of the material should carry 5% copper.

At the surface of the old shaft and cut can be seen 2 to 5 ft. of copper-stained clay-slate on end, and it is said that there is ore underfoot all along the bottom of the drive, where the formation is 2 ft. wide; and that 1 ton of 36% ore came from the drive. Some 29 tons of ore have been shipped from here. The seconds, of which there are 20 tons at grass, consist of kaolinised slate, stained on joints and carrying about 5% copper.

The three costeans between the old and new shafts have failed to expose a continuation of the ore-bodies worked. The first two are in a shattered calcareous slate, and the third is in a dark micaceous schist, in which ore-bodies may be found by sinking. At 4 ch. north-east of the old shaft, a crop of quartz has been located in schist, and blocks of ore are found on the surface in the vicinity.

At the northernmost shaft only copper-stained formation was found.

The northernmost pothole is in a decomposed calcareous tourmaline-bearing rock. Only ½ ton of copper-stained rock containing a little glance is at grass. Nothing definite can be seen.

Numerous small patches of ore are to be seen in the north-eastern part of the claim, but nothing has been done to test them, except in the one trench, on the bank of the river, which exposes slates striking north-by-east and stained, over a width of 2 ft., by copper minerals and, over 4 ft., by iron minerals. One of the crops of siliceous gossany rock is of some size, and in the vicinity bunches of ore occur in siliceous slates and schists.

Unnamed (M.C. ?).

Mgr., Cummins.

LOCATION, ETC.

This claim lies ¼ mile north of the Native Companion.

One trench, 5 ft. deep and 10 ft. long, has been opened here.

ORE-BODY.

There seems to have been a bunch here the length of the trench, striking north and south and dipping 70° to the east, in a bluish clay-slate. In the latter part of 1906, 4 tons of ore were shipped from the claim. The seconds, of which there is 1 ton at the trench, consist of siliceous limonite, with radiating spheres of malachite (sometimes coated by secondary silica) and with mammilated coatings of chrysocolla on the joints.

Good Luck (M.L. 353).

Mgr., Alman.

LOCATION, ETC.

The Good Luck lies 3 miles north-west of the Native Companion.

Its area is 9⅘ ac.

No work has been done here beyond the sinking of a few potholes.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford says:

> On the surface loose boulders of jasper, lying on mica schist and stained with green carbonate, were seen.

ORE-BODY.

The outcrop is understood to be very siliceous, but somewhat ferruginous, and is shown on the survey plan as striking north-west and south-east.

Enfield (M.L. 61).

LOCATION, ETC.

The Enfield is understood to be on Palm-tree Creek 7 miles south-south-east of the Lady Clayre.

The lease has now been abandoned.

LITERATURE.

(4) Mr. Cameron wrote:

> South of Lease No. 61 are seen vertical north and south striking mica schists and fine felspathic sandstones. Four pits sunk on indications of copper expose soft white kaolinic material carrying rich glance associated with quartz. The quartz shows free gold in coarse grains. The kaolinic material is evidently derived from the decomposition of a felspathic rock, and the ore is evidently a concentration of copper along a more or less definite line. There is no sign of a

distinct lode. Trenches further south show a considerable amount of copper staining of the rocks, but a less amount of glance. Further north, on Lease No. 61, the rocks are considerably copper-stained, and blocks of glance ore can be knocked off from many of the outcrops. Similar occurrences of ore are found over most of the leases in this neighbourhood, but on none of them has anything of much value been found up to the present.

(7) Mr. Rutherford says:

> Starting at the northern end on the "Enfield," a contorted micaceous sandstone carries in places nodules of copper glance, and is freely stained with carbonate. Three tons of rich ore were collected from the surface by Mr. Henry and sent away. Going south, the sandstone is altered to a ferruginous quartzite, which does not show any stains. Continuing sixty yards to the south the sandstone shows again on the other side of a gully and shows stains in patches. A bed of calc-spar immediately to the west also shows carbonate stains. The copper in these leases occurs in a very patchy manner in sandstone, which is scattered loosely over the surface of mica schist. . . .

Oliver Twist (M.C. ?)

Mgr., Cummins.

LOCATION, ETC.

The Oliver Twist lies 6 miles south of the Native Companion.

There are stated to be two shafts, 12 ft. and 15 ft. deep respectively.

OUTPUT.

	15 tons,*	shipped by	Cummins.
	14 ,,	,,	Bald.
Total	29 ,,	,,	

ORE-BODY.

The copper ore is reported to have had small vertical extent, presumably occurring in bunches in a vein of quartz 18 in. wide.

---

* 1 ton of this consisted of cuprite and native copper.

DUGALD RIVER.

The Dugald River groups, here dealt with, are all within 10 miles of where the Camooweal road crosses the river, 40 miles north-west of Cloncurry, though deposits have been, and others will in the future be, found southwards to the Cameron and Argylla. The ore deposits examined show more diversity of occurrence than is to be found over most of the rest of the field, and this is due to the neighbouring intrusive tongue of granite, which is continuous from here to within a few miles of the Cloncurry township. The connection between the copper ores and the granite is best exemplified at the Magnet and Mavis, more especially the latter, where copper is found with magnetite in a porphyritic rock, in juxtaposition to the granite.

Spotted schists are characteristic of the country in the vicinity of the Two Sports, but the rocks are in so decomposed a state that it cannot be determined whether the spots represent incipient secondary crystals in a sedimentary or kaolinised phenocrysts in porphyry.

UNA GROUP.

Only one mine was working here, but there is a likelihood of others being taken up in the neighbourhood, as indications of copper are abundant to the south.

No work to speak of had been done on the Una North Block, the Ivy, and the Una South, which are consequently not included here.

Una (M.L. 280).

Mgr., McGrath.

Location, Etc.

The Una lies 1 mile east of the Dugald River, 8 miles west of Quamby, on the Camooweal road, and 33½ miles north-west of Cloncurry.

Its area is 9 ac. The Leichhardt-Cloncurry Company had just taken the property over at the time of my visit.

Development.

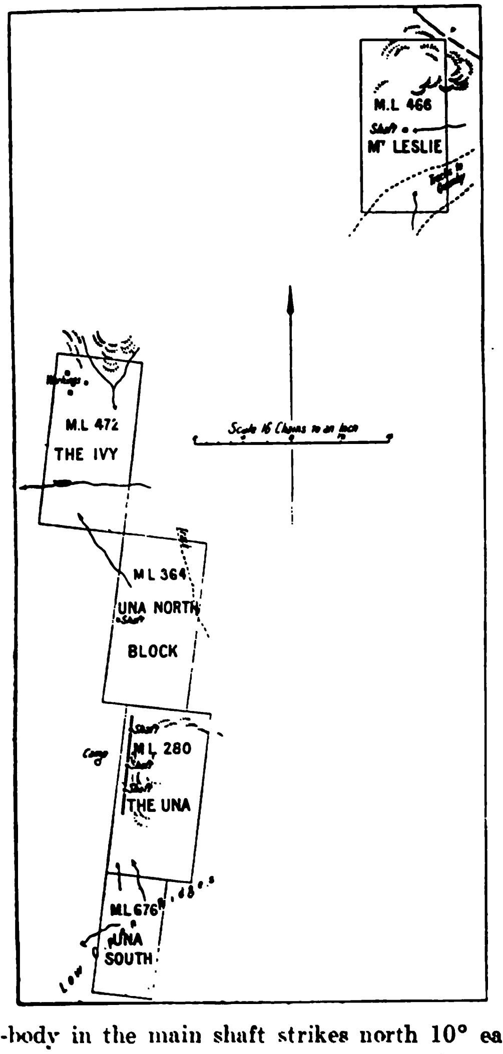
The main shaft, which is 7 ch. from the southern boundary, is 40 ft. deep; at the bottom there are drives for 30 ft. north and 20 ft. south; and above the former a stope has been carried up to within 20 ft. of the surface. No. 2 shaft, 50 ft. north of the main shaft, is 12 ft. deep. No. 3 shaft, 50 ft. further north, has been filled in to within 10 ft. from the surface with material from a trench running 12 ft. to the south. No. 4 shaft, 1 ch. north of No. 3, is 10 ft. deep. No. 5 shaft, about 75 ft. south of the main shaft, is 10 ft. deep. The only other workings are trenches 25 and 50 ft. south of No. 5 shaft, the former 20 ft. long and 6 ft. deep.

OUTPUT.

1905	... ...	12 tons shipped by Alman and party.
1906	... ...	53 ,, ,, ,, ,,
Total	...	65 ,, ,,

ORE-BODIES.

One ore-body, yielding over 50 tons of ore, has been located, a there is promise of several others being discovered by sinking on t line of strike, favourable indications having been already proved.



The ore-body in the main shaft strikes north 10° east, and di 5 in 1 to the east. The shaft was sunk on a cupriferous formatio 2 ft. wide, with a gossany footwall, and well defined from the deco posed slate hanging-wall. Along the top of the stope there is 2 ft. width of copper-stained kaolinised and silicified rock, with a few inches width of gossan on the footwall. In the face of the northern drive also the ore has pinched down to 12 in. width, but is making again underfoot. The southern drive shows only 6 in. malachite, with patches of earthy secondary sulphide in the face, and the walls are ill defined, the gossan there being on the hanging-wall side. Most of the ore shipped must have come from these workings. The whole tip is cupriferous, and should yield between 2% and 3% copper.

No. 2 shaft met only very slight and occasional stains of copper.

No ore can now be seen at No. 3 shaft, which, however, was probably sunk on a bunch, on the line of that in the main shaft.

No. 4 shaft, the farthest north, was opened in kaolinised country, but seems to have cut the cap of an ore-body at 8 ft. depth, where there is dense limonite, with a little malachite, showing.

No. 5 shaft exposes formation, but no copper is present.

The first trench to the south of No. 5 shaft, however, shows 12 in. width of copper-stained and copper-bearing altered country rock. The second trench also shows slight stains, and about 5 ch. beyond, to the south, some copper stains and replacements have been located in kaolinised and brecciated slate.

Mount Leslie (M.L. 466).

Mgr., Henry.

Location, Etc.

The Mount Leslie lies 1½ mile north-east of the Una.

Its area is 10 ac. Being deserted, it was not inspected by me.

Literature.

(4) Mr. Cameron says of the old lease:

> A shaft sunk on Lease No. 36 some 50 ft. in depth, and a drive east some 50 ft., have failed to expose indications of copper, though I am informed blocks of rich ore were found on the surface.

(7) Mr. Rutherford states:

> From a small outcrop Mr. Henry sent away seven tons of red oxide, which assayed 43 per cent. Cu., all occurring within two feet of the surface in a concretionary form.

LADY CLAYRE GROUP.

The only mine in this group offering any encouragement to continued mining is the Dispute.

Lady Clayre (M.L. 279).

Mgr., O'Keefe.

Location, Etc.

The Lady Clayre is situated on a low ridge 2½ miles north-west of the Una.

Its area is 10 ac.

Development.

The main shaft on the centre line of the lease, 5 ch. from the northern boundary, is 45 ft. deep, and a crosscut is being carried eastwards at the bottom (16 ft. in, in November last). Another shaft, 1 ch. south of the main shaft, is 19 ft. deep. A pothole 5 ft. deep lies 4 ch. from the south-western corner; besides there are costeans, just south of the main shaft, nearly 50 ft. long, 4 ch. south of the southern shaft, 6 ft. deep and 30 ft. long, and 2½ ch. west-north-west of the main shaft, 30 ft. long.

Literature.

For titles of reports, numbered as below, see Introduction.

(4) Mr. Cameron describes Lease No. 21 as below:

> . . . . The surface indications of copper have been prospected by three trenches, which expose vertical north and south, striking felspathic sandstones. The ore occurs mainly as carbonate along the bedding planes, and is associated with quartz in veins running parallel with the bedding. The most northerly cutting is 48 feet long and 10 feet in depth, and it exposes a belt of copper-bearing rock about 18 feet in width. The better ore has been picked from the gangue, and stacked on one side of the trench. An average sample of it gave a return of 15 per cent. of copper, a trace of gold, and 16 oz. 8 dwt. of silver per ton. The second trench lies about 25 yards further south, and is 40 feet in length, and about 10 feet in depth. It exposes a similar formation to trench No. 1, about 6 feet in the centre being copper-bearing. Picked ore from here gave a return of 26·4 per cent. of copper, a trace of gold, and 16 oz. 8 dwt. of silver per ton. About 70 yards further south is the trench, 30 feet in length, and 10 feet in depth. The copper-bearing rock here has narrowed considerably, being barely 1 foot in thickness. The ore apparently does not occur as a well-defined and regular lode, but is no doubt an impregnation of a narrow belt of rock. Its extension further north of trench No. 1 should be prospected by a series of cross trenches. Trench No. 1 shows that there is a good body of 15 per cent. ore to be got in its neighbourhood, but the ore does not appear to occur in any quantity further to the south. Several other outcrops of ore occur on the lease, but they do not as yet appear to be of much consequence.

(7) Mr. Rutherford writes:

> This lease encloses a low ridge of vertical ferruginous sandstone, impregnated with copper in small veins, running parallel to the bedding in a north and south direction. Starting at the northern end, a trench has been cut 47 feet across and 7 feet deep at its deepest part. It shows 29 feet of this carrying small veins of copper glance decomposing to carbonate. The southern side of this cutting shows less copper than the northern side, and the bottom of the trench is more barren than the top. Thirty yards to the south is a second trench 36 feet long and 5 feet deep, including 3 feet of vitreous quartzite, which have not been cut through. The sandstone here is much kaolinised. The north side shows a few good patches of carbonate, but the south side is almost barren. Eighty-six yards south from this second trench is a third trench 29 feet long and 8 feet deep. The sandstone here is harder than in the other trenches, and, like the second, carries the same quartzite, which has not been cut through. The walls show very few stains, and these are almost entirely confined to the quartzite. Following the same line to the south, a few stains can be seen here and there for a distance of 250 yards. Parallel to this line of impregnation, and higher up the ridge to the west, the sandstone is impregnated with carbonate in a similar way to that just described, but to a lesser degree. At the north end a trench 50 feet long and 7 feet deep shows the stains to be most plentiful in a quartzite bed which is interbedded with the sandstone. The sandstone between these two lines of impregnation at their northern ends is freely impregnated with copper of copper, and will no doubt yield to a shallow depth similar ore to that got in the northern trenches. . . .

ORE-BODIES.

Little of promise is to be distinguished here, the ore apparently occurring in small bunches. A lot of trenching has been done, the result of which has been recorded by Messrs. Cameron and Rutherford. The country rock is tilted slate (not sandstone) variously altered, chiefly by silicification, and one outcrop of limestone is to be seen on the lease. The general run is north and south, but, just to the north-west of the main shaft, the strike is west-north-west.

The main shaft has been sunk in slightly copper-stained gossany country to a "floor" at a depth of 19 ft., and similar country was met within 3 ft. of the shaft in the crosscut. This crosscut is being put in to test a belt of copper-stained and ferruginous country, exposed over a width of 25 ft. in a costean to the south of the shaft.

The southern shaft is sunk in slates, some parts of which are much silicified and bleached, while others are stained by malachite and contain bunches of fairly rich ore over a width of 6 ft. The rich ore consists of limonite, with some tile-ore and masses of malachite.

Several patches of carbonates in slate have been found to the south of this shaft, but in the southern costean only altered country with stains and small bunches of malachite-bearing slate are now exposed.

The western pothole shows impure limestone, across which a body of gossan, 12 in. to 18 in. wide, runs from east to west, probably on a joint. The gossan is rich in tile-ore and carbonates, and should yield 20% copper. A cherty quartzite lies to the east of the limestone, and on the edge of it a bunch of rich tile-ore and radiating malachite was found in quartz, the yield being 2 tons of 60% ore.

The western trench proved only copper-stained siliceous slate; but, at 1½ ch. north-west of the main shaft, there is a patch of gossan, with tile-ore and malachite, in silicified slate, from which 2½ tons of 30% ore could be culled.

Lady Clayre South (M.L. 413).

Mgr., Henry.

LOCATION, ETC.

This adjoins the Lady Clayre on the south.

Its area is 10 ac. The ground was deserted in November last.

One shaft has been sunk 10 ft., and some surfacing has been done.

ORE-BODIES.

Nothing is to be seen as to the nature of the ore-bodies, the trenches being in sintery red soil, probably produced by the decomposition of a ferruginous slate. Several tons of rich ore are stated to have been shipped from here, and there is paddocked 1 ton of siliceous limonite seconds, containing stains of malachite and specks of chrysocolla.

Dispute (M.L. 696).

Mgr., Botham.

LOCATION, ETC.

The Dispute lies 20 ch. west of the Lady Clayre. When inspected the ground was held as the Kathleen (M.C. 202).

Its area is 5 ac.

The main shaft is 20 ft. deep; a second shaft, 12 ft. deep, lie 12 ft. to the north; a third lies ½ ch. to the east; and a fourth 1½ ch. to the south-east.

OUTPUT.

	15 tons	shipped by different parties (report).
	4 ,,	at grass, carrying between 30% and 35% copper.
Total	19 ,,	

ORE-BODIES.

An oval area, 5 ch. in length (north and south) and 3 ch. in widt (east and west), in which are the workings is worthy of thorough tria the whole surface being more or less gossany. The area is on fl ground, and the easiest way to prospect it would be by sinking central shaft and then cross-cutting and driving. The underlie wi probably prove to be to the west, as the country dips in that directio

A cellular gossan crop, with slight copper stains, runs for 2 ch to the south-west from the main shaft. This should be tested b potholes or by a drive from the main shaft, at, say, 50 ft. depth. Th main shaft itself is in a gossany formation, in which occur irregula bunches of limonite carrying malachite. This, though poor, offers every encouragement to further sinking.

The northern shaft has been sunk in gossan and slate, and 9 tons of ore have been shipped.

From the eastern and south-eastern shafts 3 tons and 1½ ton have been shipped.

Balaclava (M.L. 161, Etc.).

LOCATION, ETC.

The Balaclava leases lie 2 miles north of the Lady Clayre. They have now been forfeited.

LITERATURE.

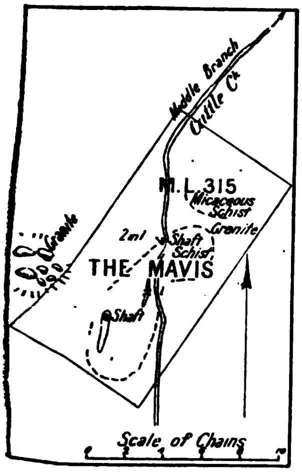
For title of report, numbered as below, see Introduction.

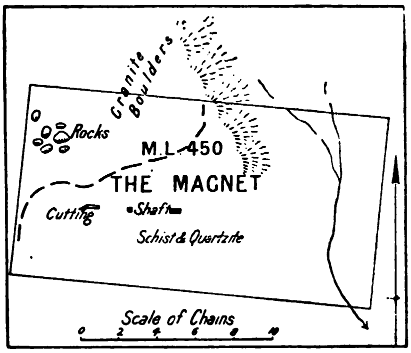
(7) Mr. Rutherford, in referring to the Balaclava leases, remarks:

> They had been taken up to enclose several disconnected patches of stained ground. The first patch seen was on the north side of a nameless creek, where six feet of the bank showed kaolinised felspathic sandstone impregnated with copper carbonate. It appeared to be a small pocket on the surface, and could not be traced in any direction. Some distance further north another small patch of stained ground was seen, and beyond a low eminence of very friable sandstone, impregnated with malachite, deposited in a radiating fibrous form in cavities in the rock. This sandstone is lying loosely on the surface of quartzite.

LONGAMUNDI GROUP.

The Longamundi Group comprises several freeholds and leases on disconnected ore-bodies, of considerable interest, because of their varied forms.





Mavis (M.L. 315).

Mgr., McGrath.

LOCATION, ETC.

The Mavis is located on Cattle Creek, 2 miles south-east of the Magnet and 1 mile from the Camooweal road.

Its area is 10 ac. At the time of my visit the lease had just been taken over by the Leichhardt-Cloncurry Company.

DEVELOPMENT.

The main shaft, underlying 2 in 1 to the north-west, is sunk below the bank and beside the bed of Cattle Creek, and is reported to be 40 ft. deep, and to have been driven from. It is now used as a well, and is consequently not to be inspected below 30 ft. from the surface.

There is an old shaft, 10 ft. deep, 4 ch. south-west of the main shaft, and an old costean 3 ch. south of the same.

OUTPUT.

1905 ... ... 13 tons shipped from Mavis, etc.

ORE-BODIES.

There is here an area of extremely metamorphosed rocks, irregularly intruded by granite. The lithological associations are indistinct, but the lease appears to be located near the periphery of the intrusive granite, the patches of black micaceous rock representing outlying "floaters" of intensely metamorphosed sedimentaries.

The deposits are of a most unusual kind, but nothing of any value is offering here. Alongside the main shaft is a dyke of pink granite, very fine in the grain, except for irregular patches of crystallised quartz and felspar giving it the character of a pegmatite. North-west of the dyke massive granite occurs, while on the south-east there is an outlier of dark schist. The shaft is sunk in a granular granitic rock—possibly a crystalline sedimentary—consisting of crystallised pink orthoclase, a little granular quartz, flakes of biotite (perhaps also with chlorite), together with some iron ore, sometimes present to the exclusion of all the other minerals. The whole of the rock is stained throughout with blue and green carbonates, but does not carry more than 1% copper. The iron ore appears to follow a joint as a footwall, and its crop can be traced for ½ ch. to the west-south-west, and to the creek drift ¼ ch. to the east-north-east. The crop of altered granite, 2½ ch. east-north-east of the shaft, is probably on the line. The iron has every appearance of being due to segregation from the intruding magma, while the copper may have been derived from basic minerals in the sedimentaries during their metamorphism.

A surface sample was taken from the material tipped alongside the shaft, but is probably too high in copper, which has been somewhat concentrated on cracks. It consists of one quarter chloritic quartz-felspar rock, stained with malachite and containing glance and also a little calcite; one half decomposed porphyritic schistose rock, stained with malachite and azurite, containing a little bornite and sometimes quartz-bearing; quartz, sometimes intercrystallised with felspar; and a little coarsely granular ilmenite with felspar phenocrysts in serpentinous rock. The following is the result of its analysis (Government Analyst):

Copper	...	...	10·6%.
Gold	...	...	1 dwt. 14 gr. per ton.
Silver	...	...	9 ,, ,,

The reddish cellular outcrop, south of the shaft, is seen in the trench to be 10 ft. across, and to consist chiefly of crystalline reddish orthoclase, in the interspaces of which is white calcite, while scattered through it are slightly rounded crystals of quartz. There is also a small quantity of chlorite, accompanied by a little malachite, and occasional grains of iron ore were noticed.

A similar outcrop is to be seen at the old shaft, where, however, stains of malachite are rather more pronounced.

Magnet (M.L. 450).

Mgr., McGrath.

LOCATION, ETC.

The Magnet is situated 1 mile south-west of the Camooweal road, 1 mile east of the Dugald River, and 36½ miles north-west of Cloncurry.

Its area is 19 ac. The lease is held under option by the Leichhardt-Cloncurry Company, but had only just been taken over at the time of my visit.

DEVELOPMENT.

The workings may best be described in their order from west to east. The first shaft is 17 ft. deep; a few feet to the east is a pothole; and 20 ft. to the east-north-east is an opencut, 45 ft. long, 6 ft. deep, and 5 ft. across. About 50 ft. east of the cut is the main shaft, 40 ft. deep, and 14 ft. beyond are two potholes 10 ft. deep. The only other excavation is a trench 30 ft. long and 8 to 10 ft. deep, 1¼ ch. east of the last.

OUTPUT.

1905	30 tons shipped by R. Love.	
1906	13 ,, ,,	(Magnet)
Total ...	43 ,, ,,	

ORE-BODIES.

There is here a series of over-lapping lenses, on a line which, east of the main shaft, lies approximately east and west, but on the opposite side gradually bends round, and in the western shaft has a strike of north-east and south-west, the dip varying from north to north-west, and amounting to 80°. The country rock adjacent to the ore-bodies is a dark mica-schist, the strike of which is generally east and west and in agreement with that of the ore-bodies. Local variations are noticeable, especially in the long cut and in the main shaft, where the schistosity abuts against the footwall as if on a cross-fissure. The wall-rocks are also there much kaolinised for 6 in. from the ore.

The ore-bodies would appear to be developed in mica schist along an imperfect line of fissures, directly due to the intrusion of the granite, which may be seen within 1 ch. west of the workings and 2 ch. to the north. The irregular contact of the two rocks, as far as visible, is the only evidence of the intrusive nature of the granite, the area to the north being, presumably, an off-shoot from the main mass to the west.

At the western shaft and pothole four separate cupriferous formations can be distinguished. The southernmost in the pothole, which is on the line of that exposed in the other workings, is probably only a bunch, 2 ft. 6 in. wide at the most. At 18 in. to the north-west a crop, 12 in. wide, runs between the pothole and the shaft; and 18 in. beyond it is a body, 3 ft. wide on the eastern side of the shaft, but only a few inches wide in the south-western corner of the same. The fourth body, which is separated from the last by 3 ft. width of quartzite, is 2 ft. 6 in. wide on the eastern side of the shaft, but tapers down to a few inches on the western. Ore has been shipped from this shaft, and the 7 tons of seconds, consisting of limonite and quartz, with malachite and a little enriched chalcopyrite, will probably average 10% copper, besides which the whole of the mullock tip should yield 2% or 3% copper.

The long cut is on a formation, 1 to 4 ft. in width, passing eastwards into quartzite, in which are occasional patches of carbonates. This can be followed almost to the main shaft, its width in one place being 10 ft. There are 7 tons of seconds at grass, very siliceous, coated with clay, and not likely to yield more than 5% copper.

The main shaft was begun on a formation, nearly 6 ft. thick. In this is a vein of gossan, which near the surface is 3 ft. wide in the eastern end, but pinches to 9 in. in the western end. Where thickest it is very siliceous, and probably does not contain more than 5% copper. Below a depth of 10 ft. the average thickness of well defined gossan on the western side of the shaft is 12 in. On the eastern side the lode pinches still further, being only 3 in. wide at 30 ft. below the surface. The whole of the material raised from the shaft shows traces of azurite, and the tip should carry between 1% and 2% copper. The paddocks hold 3 tons of gossany tile-ore and carbonates, which should run 20% copper, and 5 tons of siliceous ore worth 10% copper.

The first of the potholes exhibits a formation 7 ft. wide in the western end, and 2 ft. wide in the eastern, contracting downwards to 18 in. The seconds paddocked amount to 10 tons. They comprise siliceous gossan with carbonates, and are likely to yield 15% copper.

In the second pothole the formation increases from a width of 2 ft. 6 in. at the western end to 6 ft. at the eastern end.

The eastern trench exposes two over-lapping lenses of cupriferous gossan, perhaps 18 in. apart, the one being 12 in. wide at the western end, and the other 18 in. wide at the eastern end. The ore in the faces should carry 20% copper. The seconds, of which there are 3 tons at grass, are very siliceous, but will assay 15% copper. There is very little copper in the tip, as a whole.

O'Brien's (M.C. ?).

Mgr., O'Brien.

LOCATION, ETC.

This claim is located alongside the Camooweal road, 2 miles south-east of the Dugald River crossing.

The claim was deserted when seen.

The main shaft, which underlies 3 in 1 to the west, is 20 ft. deep, and a second, 12 ft. to the south, is 8 ft. deep.

OUTPUT.

1906 ... ... 3 tons of ore bagged.

ORE-BODY.

The shafts are in a cupriferous formation in schist country, striking north and south and underlying westwards. The total width of the formation is 2 ft. 6 in., and in this the ore occurred in bunches, of which few now show in the faces. Besides the 3 tons of ore bagged there are at grass 2 tons of seconds, very siliceous carbonate-bearing ore, the copper content of which does not exceed 10%.

Scanlan's (M.C. ?).

Mgr., Scanlan.

LOCATION, ETC.

Scanlan's lies only ¼ mile south of O'Brien's.

It was idle when visited, and only one hole has been sunk 6 ft.

OUTPUT.

1906 ... ... 2 tons of ore at grass.

ORE-BODY.

A lenticular body of ore, striking north and south and dipping westwards, is being opened in schist country. The ore consists of limonite and enriched chalcopyrite, with stains of malachite, and appears to be rich in copper. There is little quartz at the hole, but that mineral becomes more plentiful to the south.

Havelock (P.A. ?).

LOCATION, ETC.

The Havelock lies 1 mile south-east of the Patchwork.

Several small bodies of ½ to 2½ tons of ore have been found, but no defined lode has yet been located.

Patchwork (M.C. 349).

Mgr., Lanson.

LOCATION, ETC.

The Patchwork lies about 2 miles south of the Dugald Crossing on the Camooweal road.

Its area is 200 ft. × 350 ft.

A shaft has been sunk 15 ft., in the north-western corner of the claim; 3 ch. to the east-south-east is a hole 10 ft. deep; and, for 4 ch. to the east-south-east from here, a string of potholes extends.

ORE-BODIES.

The north-western shaft is in a break in the schists, striking north and south and dipping 4 in 1 to the east, here and there along which small bunches of cupriferous quartz are found. This does not appear to be worth any more attention. The 2 tons of seconds, at grass, comprise quartz, with a little chalcopyrite in the solid part and tile-ore and carbonates in cracks; and they may carry 2% copper.

The first hole to the east-south-east was sunk on a bunch of ore, running west-north-west, which has now been stoped out.

The potholes to the east-south-east appear to have been opened on small bunches of copper ore and of quartz carrying magnetite, no body of which has, however, been proven, though a formation 2 ft. 6 in. wide is exposed in one of the holes.

The deposits are valueless copper propositions, but the occurrence of the iron ore is interesting.

Two Sports (M F. 2874).

Mgr., Henry.

LOCATION, ETC.

This is on the western side of the Dugald River, 1 mile above the Camooweal road crossing and 38½ miles north-west of Cloncurry. When visited by me a claim known as the Two Sports had been pegged out, there being nothing to indicate that the ground was freehold.

Its area is 31 ac.

The Dugald valley is here flat bottomed or only slightly rolling to the hills 3 miles to the west.

DEVELOPMENT.

Most of the workings described below are due to prospectors, who have held the ground in ignorance of the fact that it is freehold.

The northernmost opening is a pothole (*a*); 5 ch. to the south is a costean (*b*), 4 ft. deep and several feet long; then, 5 ch. to the south-south-east of the last is a trench (*c*), 15 ft. long and originally 10 ft. deep; 30 ft. beyond is a hole (*d*), 5 ft. long, 10 ft. wide, and 5 to 10 ft. deep; 1 ch. further to the south-east is a pothole (*e*), 3 ft. deep; ¾ ch. east-north-east of the last is a pothole (*f*), 5 ft. deep; and 3 ch. east-south-east is a trench (*g*), 20 ft. long and up to 10 ft. deep; 3 ch. to the west-south-west of the last are two or three potholes (*h*), up to 10 ft. deep; 5 ch. south of these potholes is the latest working, a pothole (*i*), 6 ft. deep; and 2 ch. south of this is a costean (*j*), 50 ft. long and 8 ft. deep.

OUTPUT.

1906 ... ... 15 tons of ore bagged, estimated to carry 40% copper.

ORE-BODIES.

Copper-stained spotted schistose slate here occurs over a belt 20 ch. in length and 3 ch. in width. The strata are tilted vertically, the strike being north and south.

The northernmost pothole (*a*) exposes only slightly stained spotted schist, dipping steeply eastwards, as in the costean (*b*). Between these old workings there is a belt, 1 ch. wide, which is bare of all vegetation, even spinifex, except copper grass.

Between the costean (*b*) and the trench (*c*) the country becomes much more ferruginous, and in the sides of the trench spotted schist with much silicified limonite can be seen. There are 2 tons of ore bagged here, and also 3 tons of ferruginous seconds, which may carry 3% copper.

The tip at the hole (*d*) contains a large amount of gossan. There seem to be two separate lenses of ore in this excavation. They are now covered by rubble, but are said to be strong in the bottoms of the workings. The firsts bagged amount to 9 tons, and the seconds, carrying 3% copper, to 8 tons. This hole is on the line of the main outcrops of the freehold, which appear at 5 ch., 8 ch., and 11 ch. to the south, but have not elsewhere been broken into.

The potholes (*e* and *f*) exhibit only stained spotted schist.

In the trench (*g*) a lenticular bunch of gossany ore would seem to have been worked, but in the end only a few inches of blackened limonite, dipping flatly northwards, can be seen. One ton of firsts is stacked at the trench, and there is near at hand 1 ton of gossany seconds containing 1% copper.

The potholes (*h*) are in copper-stained spotted schist, and 2½ tons of ore, now bagged near them, have been obtained from bunches of ore.

The newest hole (*i*) is also in spotted schist stained by malachite, and containing irregular splashes of cuprite. In working, green-stained cracks are followed till irregular veins and bunches, generally less than 1 in. thick, of cuprite are found, sometimes with a little native copper. Only ½ ton of rich firsts were bagged here, but there was also 1 ton of seconds, schist with veins of cuprite and stains of malachite, estimated to contain 25% copper.

The schists are stained to a limited extent for 1 ch. south of the hole. The southernmost costean shows very slight stains of copper in places. Some prospecting should be done on the gossany crop to the south-south-east of this.

Unnamed (M.F.'s 2873, 2902, and 2903).

LOCATION, ETC.

These freeholds lie 1½ mile west of M.F. 2874 on the Dugald River.

Their areas are 21 ac., 20 ac., and 20 ac., respectively.

LITERATURE.

(2) Mr. Jack refers to several copper and lead lodes in this district, but his description of location is insufficient for it to be stated that they are on these freeholds.

> . . . . The lead selections lie nearest the range, and occur in a wide lode which can be followed on the surface for nearly a mile, from north 20 degrees west, to south 20 degrees east; not only by the continuous outcrop of gossan,

but also by the absence of vegetation. At the north end is a mass of gossan, stained with carbonate of copper, and mixed with plumbago. . . . A mile to the south-east of the lead lode is the No. 1 Copper Selection. It lies among upturned and altered stratified rocks. Near the river is a white crystalline limestone, 50 or 60 feet thick, with siliceous granules, and specks of black mica, dipping at 75 degrees to east 10 degrees south. Below the limestone is a series of grey siliceous and talcose slates or shales, impregnated and coated with green carbonate of copper. This series is of varying thickness—at least 100 feet—and is accompanied by a weathered granular siliceous and hornblendic rock, impregnated with carbonate of copper ("green gossan"), especially in the form of amygdaloidal kernels. These masses evidently are not part of the stratified series, but vein deposits or gangue, as they intersect the bedding in places, although their general tendency is to follow it. Two trenches have been cut across the outcrop of the cupriferous zone or lode (which runs north 10 degrees east). One trench is 22 yards long; it discloses a considerable quantity of the "green gossan," which cuts in and out of the bedding of the stratified rocks. The second trench is 20 feet long and 8 feet deep; it shows towards the bottom large blocks of ruby oxide coated with green carbonate, and frequently containing veins of native copper. The oxide is remarkably pure. Besides the "green gossan" large masses of ferruginous gossan occur on the cap of the lode. Large lumps of carbonate and oxide of copper can be picked up loose in the gullies near the lode.

CABBAGE-TREE GROUP.

Cabbage-tree Creek is a tributary of the Leichhardt River, but it is convenient to include these workings under the heading of Dugald River.

It was learnt from prospectors that there is an extensive cupriferous belt along the right bank of Cabbage-tree Creek, but that the ore-bodies themselves are small.

Cabbage-tree (M.F. 3072).

LOCATION, ETC.

This is on the eastern side of Cabbage-tree Creek, 4½ miles north-north-east of the crossing of the Camooweal Road Crossing.

Its area is 40 ac. It was deserted last year, and was therefore not inspected by me.

LITERATURE.

For title of report, numbered as below, see Introduction.

(7) Mr. Rutherford wrote:

> It shows felspathic sandstone impregnated in patches to a depth of a few feet from the surface by carbonate of copper. Four trenches were examined, and all showed impregnation to be to a shallow depth. The carbonate seemed to be due to the oxidation of glance, some bits of which were seen occurring in nodules on the surface.

GLENROY.

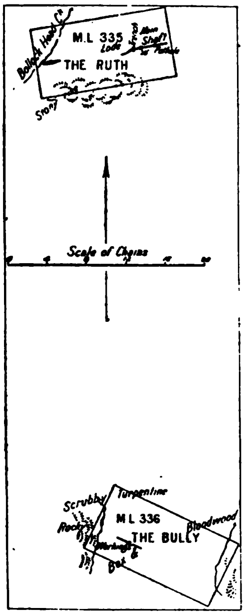
Glenroy is a station on the Leichhardt River, 53 miles west-north-west of Cloncurry.

The two groups are located on the divide between the river and Prospector Creek, which lies to the east.

MOUNT REMARKABLE GROUP.

Mount Remarkable is a conspicuous table-topped range, running for several miles along the western side of Prospector Creek, and beneath the northern end of it the Cloncurry-Camooweal mail road runs.

On the Bully very little work had been done at the end of last year, and, being then deserted, the lease was not visited.



Ruth (M.L. 335).

Mgr., Fisher.

LOCATION, ETC.

The Ruth is situated on a small branch (Bullockhead Creek) of Prospector's Creek, ½ mile from the Camooweal road and 50½ miles north-west-by-west from Cloncurry.

Its area is 10 ac.

The main shaft is 30 ft. deep; 1 ch. to the east there is a hole 8 ft. deep; 4 ft. to the south there is a trench, 10 ft. long; 12 ft. to the west there is a cut, 12 ft. long and 20 ft. deep; and 3 ft. beyond this a trench, 12 ft. long and 4 ft. wide, has been sunk 5 ft.

The mine happened to be deserted when visited, the leaseholders having left for Cloncurry to obtain rations.

OUTPUT.

1905	... ...	18 tons shipped.	
1906	... ...	39 ,, ,,	
Total	...	57 ,, ,,	averaging 25% copper.

ORE-BODIES.

This appears to be a mineralised zone, in which there are probably numbers of ore-bearing lenses, but there is no sign of fissuring. Iron-stained quartzite, in which a few small patches of copper-ore have been found, forms a prominent crop, rising 15 ft. above the creek at the western end of the lease.

The crop is 3 ch. in length and up to 20 ft. in width at the western end. It strikes west-south-west and dips steeply south-south-east. Towards the west it is made up of alternating quartzite lenses, granular quartzite and crushed schist, most of the copper being in the last and none in the first. The average content is less than 5% copper, though the green surface stains might lead one to expect a higher percentage. The occurrence is thus almost exactly similar to that on the Chinaman freehold at Duck Creek. The central part of the crop is rather gossany, and patches of ore may be expected if it is sunk on. In the trench near the centre 9 to 18 in. width of quartz-bearing limonite, carrying malachite with a little chalcocite, is visible. It is understood that a little ore has been sent away from here.

The main shaft appears to have been opened on a crop of rich ore, which, however, thinned out eastwards and cannot be traced beyond the 8-ft. pothole, though there are slight indications 10 ch. to the east-north-east. Towards the west the crop breaks up into a number of over-lapping cellular, gossany lenses, the general trend there being west-south-west, whereas at the workings it is west 5° south.

At 15 ft. depth in the main shaft can be seen 3 ft. width of malachite-impregnated limonite on the north, 18 in. iron-stained slate and 12 in. cupriferous gossan on the south. At 20 ft. depth an inclusion of country rock proves the ore to be simply a bunch of replaced country. Cellular gossan, with secondary sulphides, has been raised from the lowest part of the shaft. The whole tip at the main shaft, containing, say, 50 tons of material, should run 15% copper.

In the western pothole there is 6 in. gossan and cupriferous formation, and several tons of gossan, carrying 5% copper, could be picked from the tip.

The first trench, to the west of the shaft, exposes 18 in. gossan at its eastern end, but at the western only 3 ft. of ill-defined gossany formation can be made out.

HAMILTON CREEK GROUP.

Hamilton Creek is a tributary of Prospector Creek, about 10 miles east of Glenroy homestead.

The group includes the following, which have been taken up since my visit to the district:—

Brideson's "Manxman" (M.L. 695), 10 ac.
Kennedy's "Mount Olive" (M.L. 674), 10 ac.
Brown's "Gipsy's Warning" (M.L. 682), 10 ac.
Smith's "May Queen" (M.L. 683), 5 ac.

Yamamilla (M.F. 2885).

LOCATION, ETC.

The Yamamilla is located on the head of a creek of the same name, within the catchment area of the Dugald River. It, however, is really in the upper Prospector Creek group of ore-bodies.

Its area is 20 ac.

LITERATURE.

For title of reports, numbered as below, see Introduction.

(4) Mr. Cameron wrote of the freehold:

> . . . It shows an enormous reef of white quartzite running through the property in a north and south direction, and forming the backbone of the ridge through which Yamamilla Creek cuts near the northern boundary. The outcrop thus exposed stands out as a solid wall running down to the spur of the ridge some 20 feet high and 15 feet across. The face of the wall is cavernous, and stained green with copper salts. It shows the reef to consist of broken fragments of quartz cemented together by secondary silica, and with copper carbonate scattered through it. A sample of some of the best ore gave a return of 9·9 per cent. of copper, a trace of gold, and 3 oz. ·7 dwt. of silver per ton. There does not appear to be any great body of ore present on the surface, and the lode evidently gets poorer as it is traced to the south. The quartzite on the whole has a very hard and barren appearance, the patches of ore being detached and comparatively scanty. The rich colouring of the surface of the lode is easily explained by the readiness with which copper is dissolved out and distributed by water, the colouring being in many instances merely a coating of carbonate on the lode material.
>
> *Lease* No. 159 is taken up on the continuation of the quartzite beds in the Yamamilla. It does not show much indication at present of being rich in copper.

(7) Mr. Rutherford states:

It is taken up to include a quartz outcrop running north and south in a country of quartzite. The northern end has been cut through by a creek, which shows that in depth the outcrop splits into two branches. Forty feet above the level of the bed of the creek and south from it, the outcrop shows as a mass of quartz 15 feet high and 17 feet wide, stained with carbonate. To the north this blow splits into two branches, running for a distance of eighty yards to the creek and showing for some distance beyond. These branches, like the rest of the outcrop, are composed of blocks of quartz cemented together and showing carbonate stains in joints. They become narrower and poorer in depth as the hill is descended, and in the bed of the creek show from 1 to 2 feet wide with few stains. Continuing the blow to the south it is found to bifucrate also in this direction. The eastern branch can be traced only for a few yards, but the western branch is marked by a fairly well defined line of quartz running into "Mount Hood" (Lease No. 159, 20 acres), adjoining to the south. This southern part of the outcrop is much less stained with carbonate than the large blow. This is not a true outcrop, but a deposition of silica containing copper along the bedding of the altered sandstone. The vivid green colour is due to a thin coating of the rock, and a bulk assay right across the quartz would not show more than a trace of copper.

PROSPECTOR CREEK.

Prospector Creek runs northwards from near the head of the Dugald to the large east and west stretch of the Leichhardt River.

Only five groups are here mentioned, but they do not include every show in this part of the district that has been tried at one time or another.

The creek drains a wide flat-bottomed valley, fairly well timbered with stunted box, with bunches of gidia and bloodwood in the lower part.

MOUNT METALLIC GROUP.

This group is on the western side of the creek, about 3 miles north of the Camooweal road. Included in it here are several holdings lying to the west and south-west not visited by me.

The country is characterised by the presence of much limestone, in which, however, no trace of fossils can be detected, for the region has undergone considerable metamorphism. In the vicinity of where the miners camp at the White Gorge, within a mile to the north of Mount Metallic, the limestones are thin bedded and strike north 10° east, and here some small lenses of hæmatite have been developed. Northwards towards the Dreadnought there seem to have been thicker beds of limestone, in which crystalline quartz has been deposited. Ferruginous chalcedony has also subsequently been introduced, replacing most of the limestone and cementing the broken fragments of quartz. Silicification, with consequent induration, has also been particularly intense over whole beds of slate, in which the deposition of silica has been not only in cracks and joints but throughout the body of the rock. The superior resistance to denudation of the resulting rock causes it to stand out as a rampart, often forming the backbone of a hogbacked mountain. By many of the miners the crops are looked upon as caps of huge lodes.

Mount Metallic (R.C. 310).

Mgr., Price.

LOCATION, ETC.

Mount Metallic is located on the divide west of Prospector Creek and 2½ miles north-west of the Camooweal mail road crossing. The hogback on which it is situated converges towards the White Gorge range.

Its area is 40 ac.

DEVELOPMENT.

No. 1 shaft, 10 ft. deep, with opencuts extending 6 ft. south-east and 15 ft. north-west, is a little south of the middle of the claim. Between this and the main (No. 2) shaft, 1 ch. to the north-west, there are two opencuts, 12 ft. and 10 ft. in length and 8 ft. deep. No. 2 shaft is 28 ft. deep and underlies 2 in 1 to the east. No. 3 shaft, 20 ft. to the north-north-west, is 47 ft. deep, and inaccessible. From this an opencut, 10 ft. deep, continues for 25 ft. northwards. No. 4 shaft is 4 ch. north-north-west of No. 3, and is 20 ft. deep. In addition to these workings there is an opencut, 10 ft. deep, running for 30 ft. west-north-west from the opencut at No. 3 shaft.

OUTPUT.

Prior 1906	...	45 tons shipped, carrying 35% copper (*fide* Mr. Price).
1906	...	25 ,, ,,
Total	...	70 ,, ,,

ORE-BODIES.

The crop, at the south-east, comprised cellular limonite, with melaconite (?) and malachite lining cavities. The ore-body, in the No. 1 shaft and the adjacent opencuts (where, however, there are strings in the footwall for 12 in. from the ore-body), is only 6 in. wide. But the limonite there carries chalcopyrite, enriched by chalcocite, while a little jagged (crystalline?) native copper has been found, embedded in cuprite, which gradually shades off into limonite, mammilary on cavities. There is now 15 cwt. of native copper and cuprite at the shaft. The strike of the lode here is north 28° west, its inclination being almost vertical. The country rock is a siliceous cherty slate.

Very little ore can be seen in the northern end of No. 2 shaft, but the seam, dipping 2 in 1 eastwards, on the southern end averages 12 in., of which the 4 in. on the hanging-wall is chalcopyrite enriched by chalcocite, while the remainder is a siliceous skeleton with a little crystalline malachite. The copper ore is increasing somewhat towards the bottom, where tile-ore is also appearing. The walls here are well defined, but show no slickensides, though irregular polished vertical faces occur for 2 ft. 6 in. from the ore in the footwall country, which for that distance is gossany and cellular (probably owing to leaching), and is to be looked on as a formation, in which copper may appear at any time. There is 1 ton of ore bagged at the shaft, consisting chiefly of an intimate mixture of chalcocite and malachite. My sample (35/B) was taken from one of the bags at No. 2 shaft. It consists of limonite, with malachite disseminated and filling cavities and cracks, with an impregnating glance, and with sporadic crystals of pyrite; of massive glance with scattered crystals of pyrite and coats of malachite on cracks; of earthy malachite, accompanying kaolin; and a very little secondary quartz, drusy in cavities in the limonite, but there is no original quartz present. One specimen consists internally of reddish limonite, containing a few specks of pyrite and surrounded by crystalline glance, on which is an external coat of drusy malachite. The sample assays (Government Analyst):

Copper	... ...	39·8%.
Gold	... ...	Tr.
Silver	... ...	1 oz. 16 dwt. per ton.

It is reported that there is 2 ft. of ore in the bottom of No. 3 shaft, but, in the end of the opencut to the north, the width is only 9 in. The country here appears to be strikingly obliquely to the orebody.

The practically vertical streak of rich ore, beside 3 or 4 in. gossany kaolin, in No. 4 shaft is only 1 to 3 in. thick, except at the bottom of the shaft, where the gossan is 12 in. wide at the northern end. The eastern slate wall in places is very well defined, and, if followed, may lead to a bunch of ore. The 2 tons bagged at the shaft comprise siliceous tile-ore and chalcocite-chalcopyrite, and are expected to yield 30% copper.

The cut west of No. 3 shaft exposes 3 to 6 in. gossan, which, though in the cut reported to be 2 ft. wide in places, appears to follow a west-north-west striking joint, dipping 6 in 1 to the north-north-east. The walls are strong, but the hanging-wall country is altered for 18 in. from the ore, and is very gossany. The gossan can be traced for several chains to the west of the cut.

The Mount Metallic country would seem to be on the continuation of that on which is the Dreadnought, and though no limestone was seen on the claim it is known to occur on the hill to the south.

Queenslander (M.L. 436).

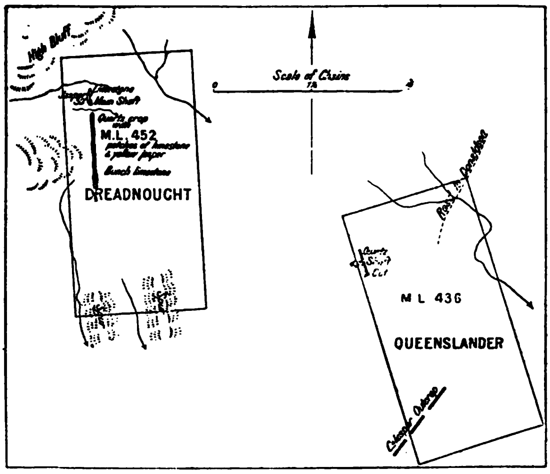
Mgr., Price.

LOCATION, ETC.

The Queenslander lies north 33° east from Mount Metallic, at a distance of 1½ mile.

Its area is 20 ac.

Only one shaft and a pothole have been sunk on this lease, the former to a depth of 45 ft., and the latter 6 ft. A drive is being carried southwards from the shaft bottom.



OUTPUT.

	4	tons shipped, carrying	35% copper.
	6	„ „ „	22¼% „
1906 ...	7	„ „	
Total	17	„ „	

ORE-BODIES.

The ore-body appears to run south 25° east from the main shaft, and traces of copper can be found for nearly a mile in that direction, but exposures are few and far between. Quartz fragments are scattered over the surface for 40 ft. north of the shaft.

At the main shaft the crop is a somewhat gossany and copper-stained material, which passed at 32 ft. depth into a sintery formation, carrying bunches of copper ore, yellow jasper, and brown calcite, 15 in. wide at the northern end and 3 ft. wide at the southern. The footwall, on which there is 6 in. of crushed lime-bearing slate, is well defined, and dips 1 in 4 to the east-north-east, but no hanging-wall can be distinguished. Bunches of rich ore have been found in the drive for 8 ft. from the shaft, especially about 2 ft. from the footwall. Some 10 tons of ore have been shipped from this shaft, there are 25 tons of seconds, carrying 16% to 18% copper, at grass, and the whole tip will carry between 5% and 10% copper. The last 1½ ton of ore raised, and waiting to be sorted, should yield 28% copper. It consists of chalcopyrite, intimately associated with chalcocite, a little earthy lime, and quartz, and shows some stains of malachite. The same quantity of firsts, paddocked and comprising nearly pure chalcopyrite-chalcocite ore, is expected to assay 48% copper.

The pothole is on a cupriferous, slightly gossany formation, 18 in. wide at the northern end but only 7 in. wide at the southern. In all, 4 tons of 28% ore have been shipped, and there are 5 tons of seconds (5% copper) at grass.

Too little can be seen of the crop for any more favourable statement to be made than that continued sinking is advisable, with the simultaneous opening of costeans. Water level is to be expected at about the 70-ft. level.

A small crop of limestone was seen about 5 ch. north-east of the workings.

Just outside the Queenslander, to the west, is a north and south vertical vein of calcite up to 18 in. in thickness, from the surface of which a few tons of ore have been collected and bagged.

There is also an old shaft, 15 ft. deep, about 10 ch. south-west of the north-western corner peg of the lease. It is on a formation, 12 in. wide at the surface, in schist, dipping 70° to the south-west, and traceable for 3 ch. to the north-west. Only 2 tons of 24% ore have been taken from here.

Dreadnought (M.L. 452).

Mgr., Donner.

LOCATION, ETC.

The Dreadnought, formerly held as M.L. 115, lies $\frac{1}{4}$ mile west of the Queenslander, and $\frac{1}{2}$ mile north-north-east of the White Gorge.

Its area is 20 ac.

A shaft has been sunk, 4 ch. south-east of the north-western corner peg, to a depth of 30 ft., and a contract was let at the end of 1906 to continue the shaft to a total depth of 67 ft. It is proposed to cross-cut east and west at the 50-ft. level.

ORE-BODIES.

The main outcrop, in which is the shaft, consists of limestone, replaced by silica and limonite, some of which is very cellular. It is 40 ft. in length and perhaps 15 ft. wide, though boulders of the rock are spread over a width of 30 ft. Interesting specimens are here available of ferruginous, granular quartz, pseudomorphous after calcite, as proved by a well-marked rhombohedral cleavage exhibited.

The sinking in the shaft was silicified limonite or ferruginous jasper, the 35 tons of which at grass will probably run 3% copper, but are valueless because of the very high silica content. The lower part of the shaft is just passing into soft kaolinic formation, which, however, contains no copper. The limonite is in bands, which dip 60° to the west; that at the 14-ft. level contains bunches of pyrite as well as copper stains. Sinking and cross-cutting appears to be justified.

An area of limestone, 10 ft. in diameter, is to be seen on the northern side of the ferruginous crop, and, 20 ft. south of the shaft, there is a crop of barren quartz, showing some patches of limestone, silicified limestone, and silicified limonite. This crop is 7 ch. in length and up to 15 ft. in width.

Other irregular crops of limestone occur 10 ch. south of the Dreadnought. There are also areas, up to 40 ft. and even 50 ft. wide and 4 ch. long, of "pudding-stone," consisting of angular quartz cemented by a ferruginous chalcedony (silicified limonite), beneath which copper ores may be found.

Kangaroo (P.A. 261).

Mgr., Price.

Location, Etc.

The Kangaroo lies 4 miles west of the Mount Metallic.

Its area is 40 ac.

There is one opencut 30 ft. long and 16 ft. deep.

Output.

4 tons trial shipment, 22% copper.

Great Northern (P.A. 242).

Mgr., Price.

Location, Etc.

The Great Northern lies 5 miles north-north-west of Mount Metallic.

Its area is 20 ac.

Only cuttings have been opened, and no ore has been shipped.

Ore-body.

Mr. Price reports an outcrop showing ironstone and limestone, over a width of 80 ft., running for ½ mile, and rising in places 50 ft. above the flats.

Lady Ethel Florence (P.A. 265).

Mgr., Price.

Location, Etc.

The Lady Ethel Florence is 2 miles west of the Great Northern.

Its area is 160 ac.

Only shallow cuttings have been made here.

Output.

4 tons trial shipment, 22% copper.

Mount Joseph (P.A. 288).

Mgr., Turner.

Location, Etc.

Mount Joseph is 6 miles north-west of Mount Lucas, at the head of Middle Creek.

Its area is 40 ac.

Output.

1906 ... ... 4 tons shipped by J. Turner. Source doubtful.

Mount Lucas (P.A. ?).

Mgr., Turner.

Location, Etc.

Mount Lucas is on the Bowerbird road at the head of Bora Creek, and within 2 miles of Mount Cubrabunia.

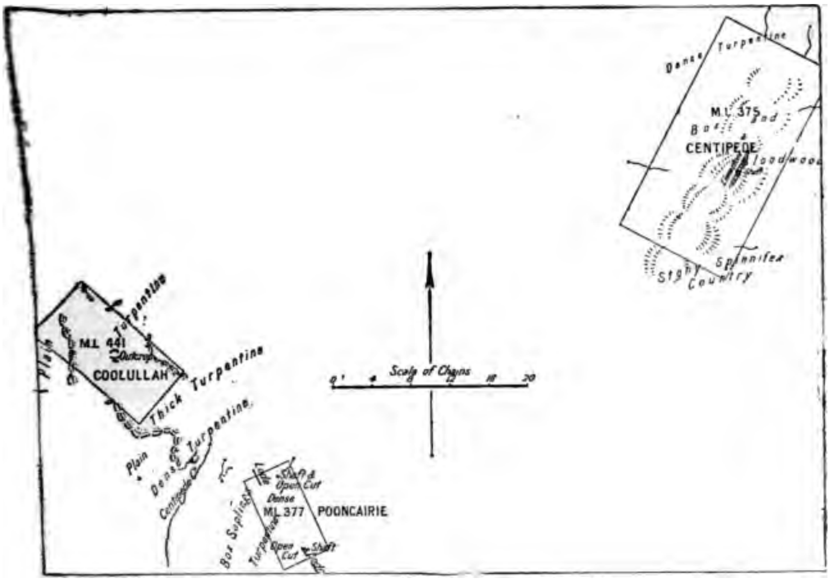
Its area is 160 ac.

Output.

1906 ... ... 2 tons shipped (T. Turner, Mount Remarkable).
7 ,, at grass, carrying 30% copper.

CENTIPEDE GROUP.

This group comprises four leases in the vicinity of the junction of Prospector Creek with the Leichhardt River. None of them had been worked for a considerable time, and it was found possible to locate only the Centipede in the time available.



On the Coolullah (M.L. 441) and Emerald Hill (M.L. 440) no work has been done.

Centipede (M.L. 375).

LOCATION, ETC.

The Centipede is located within the catchment area of the creek of the same name, 5 miles south from the junction of Prospector Creek with the Leichhardt River. This is in a region of broken gullies and low hills, extending for miles to the south-east from the Prospector Creek flood plain.

The area of the lease is 28 ac.

LITERATURE.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron wrote:

> *The Centipede* is a lenticular bed of limestone at the southern end, containing copper disseminated in particles through it. Two trenches have been put into it on its western side, but do not disclose ore of any great prospect. Further north the limestone is replaced by silica, and shows some likely-looking patches of cupriferous material.

DEVELOPMENT.

The lease had long been deserted, and was only found after long search by my blackboy. There is one trench 15 ft. long, and 15 ft. west of it is a shaft, 35 ft. deep, from the bottom of which, it is said, a crosscut runs 18 ft. to the east. Other trenches have been made 10 ch. to the south-south-west.

ORE-BODIES.

To the north-east of the lease many north and south belts of siliceous limestone were observed in slate and schist country. The limestones towards the west have lumps and veins of quartz segregated in them, and occasionally quartz is found to replace the whole width of a bed over a distance of from 1 to 5 ch. and a width of up to 1 ch., when they often rise 50 ft. above the general level of the ridges. In the vicinity of the lease bunches of gossan and traces of copper are also found.

The trench has been opened in a ferruginous crop of limestone, 15 ft. wide, which strikes north-north-east and dips 70° westwards. It exposes only 4 ft. width of quartz and siliceous copper-stained limonite in limestone. Very small splashes of chalcopyrite and erubescite were noticed in the solid quartz, and of chalcopyrite in the limestone, from which a little malachite weathers out. There are 2 cwt. of green-stained limonite at grass which may yield 2% copper.

The shaft has been sunk to prove this body at a depth. The upper part is in friable slaty rock, and at 30 ft. from the surface siliceous and ferruginous limestone, carrying only slight stains of copper, has been struck. No further work is warranted here.

The southern workings are in a big blow of ferruginous limestone, carrying very little silica (chiefly crystallised in cavities) and only stains of copper. Occasional specks of chalcopyrite were noticed in the limestone, and pseudomorphous crystals of limonite after chalcopyrite weather out on the surface.

Pooncairie (M.L. 377).

LOCATION, ETC.

The Pooncairie lies ¾ mile west-south-west of the Centipede.

Its area is 5 ac.

Mr. Cherry has stated that a shaft has been sunk 75 ft., and that a drive runs west for 42 ft. at the 55-ft. level.

LITERATURE.

For title of report, numbered as below, see Introduction.

(4) Mr. Cameron reported:

> *The Pooncairie* Lode lies about 3 miles south of the junction of Prospector's Creek and the Leichhardt River. It shows an outcrop of siliceous rock running parallel to the bedding of the north and south striking talcose schists. A trench across it exposes about 10 feet of lode material carrying oxide of copper in irregular seams, and lining the vughs in the rock. A shaft about 16 feet from

the eastern wall of the lode is down 35 feet, and a drive to the west just above the water-line has passed through 18 feet of the siliceous outcrop. Mr. Green, who visited the locality some months after our first visit, says that the siliceous rock does not contain the same amount of copper in the drive as on the surface. The lode is apparently secondary silica dissolved out from the schists on either side, and has become impregnated with copper leached out also from the country rock.

ORE-BODIES.

Ruby ore is said to have been found here, but no mention is made of any body of ore, the shaft being sunk in soft country.

SURPRISE GROUP.

The group is located in the rather inaccessible mountainous country between the Pinnacles and Prospector Creeks.

No particulars are available of the Surprise* (M.L. 261), Surprise South† (M.L. 262), and Mount Ferrum (M.L. 443), of which the first two are 5 miles north-east of Mount Metallic, and the last is within a mile north of the Pinnacles waterhole on the Camooweal road, midway between Cabbage-tree and Prospector Creeks.

Jumbo (M.L. 442).

Mgr., Power.

LOCATION, ETC.

The Jumbo adjoins the Surprise on the north-west.

Its area is 30 ac.

ORE-BODY.

Mr. Cherry, in 1903, reported here "a very large and continuous quartzite outcrop . . . which shows traces of carbonates."

---

* The manager of the Mount Cuthbert reported late in this year (1907) that a well had been sunk as well as an underlie shaft 28 ft. deep, on a promising lode.

† The manager reported in October, 1907, that a costean had been put across the lode showing it to be 12 to 14 ft. wide, and to consist mostly of gossan and siliceous iron, copper stained.

LEICHHARDT RIVER.

In speaking of the Leichhardt River mines those on the big bend are always meant, as otherwise it would be necessary to include a region nearly 100 miles in length. The groups included are the Mount Cuthbert, Mighty Atom, and Jessie's Dream, practically all within the catchment of Six-mile Creek.

Schists, with lenticular beds of limestone and huge outcrops of quartzite, are characteristic of the eastern portion of this district, but westwards porphyritic rocks are present in great abundance.

MIGHTY ATOM GROUP.

The mines of this group are almost all located in the flat-bottomed valley drained by St. Paul's Creek (running northwards) and Six-mile Creek (running southwards). The surface is covered with angular quartz and ironstone gravel, and carries only a thin sprinkling of stunted mountain gum and spinifex.

The country is similar to that within the Prospector Creek catchment in showing crops of bedded limestone replaced to a greater or less extent by quartz and accompanied by some copper ore, quite possibly precipitated by the action of the lime.

A note may be made here of the rumoured occurrence of alluvial gold, at the head of Copper-mine Creek, within a few chains to the north of the Mighty Atom. Mr. McKeand reports colours to be well distributed, and on one occasion discovered a 1½-dwt. slug. We are unable to do any prospecting, as the gullies were dry.

Mighty Atom (M.L. 274).

Mgr., McKeand.

Location, Etc.

The Mighty Atom is located on the divide between the Six-mile and Copper-mine Creeks, at the head of the eastern branch of the former.

Its area is 20 ac.

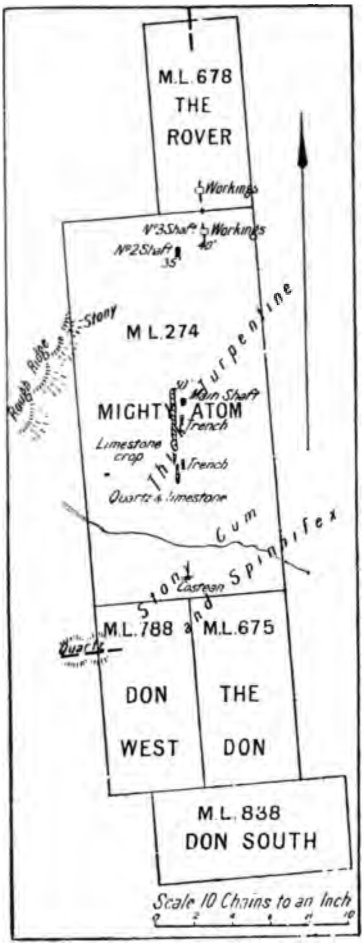
Development.

A costean, 40 ft. long, 6 ft. wide, and 3 to 5 ft. deep (near the middle of which is a caved-in shaft, 15 ft. deep), is 1 ch. north of the centre of the southern boundary. At 6 ch. to the north there is a trench; 2 ch. beyond that there is another trench, 10 ft. long and 5 ft. deep. No. 1 shaft, which is 30 ft. deep, and in a state of collapse, lies 1 ch. further north. About 4 ch. north of No. 1 shaft there are two trenches, and 4 ch. beyond them is No. 2 shaft, underlying 1 in 1 and 35 ft. deep, but falling in. No. 3 shaft, 40 ft. deep and inaccessible, is 1 ch. to the north-east of No. 2 and 3½ ch. from the north-eastern corner peg.

The workings, which are the result of the Melbourne Coolullah Option Syndicate's tenure, have been so long (about six years) standing that the exposures in them are of little use.

OUTPUT.

18 tons shipped, carrying 24½ to 43½% copper.



ORE-BODY.

The Mighty Atom workings lie along, or adjacent to, the outcrop of a bed of quartz-veined limestone, replaced to some extent by iron and silica.

For 5 ft. east and 5 ft. west of the shaft in the southern costean, the country (soft schist or slate) is more or less cupriferous, the mixed azurite, malachite, glance, and tile-ore occurring in small irregular masses with a little chrysocolla. There is no defined ore-body, but, just east of the shaft, there is a band, 18 in. to 2 ft. wide, of more richly cupriferous and ferruginous country, which dips 85° to the east 5° north. Possibly payable, but low-grade, schist will be found below. Only 5 tons of 39% ore have been shipped from here, but there are 15 tons of seconds at grass, chiefly kaolinised slate, which may carry 10% copper and are almost free from quartz.

Across the gully to the north of the costean there is a crop of gossan and yellow jasper giving way northwards to limestone, alongside of which is the first trench, from which 9 tons of ore, containing 43½% copper, have been shipped. The 3 tons of seconds (malachite and tile-ore in limonite with a little quartz) left, carry 20% copper. Nothing can be seen of the ore now in the trench.

The second trench is on the eastern side of the continuation of the limestone, which is there quartz veined, but nothing can be made out in it. It is said that some soft black gossan was raised, and that 3 tons shipped yielded 24½% copper. There are also at grass 3 tons of siliceous limonite carrying fine-grained tile-ore, glance, and malachite, worth perhaps 5% copper.

Quartz crops 5 ft. west of No. 1 shaft, beyond it there is 5 ft. width of chrysocolla-bearing country, and then 21 ft. width of crystalline limestone, the first 12 in. of which is schistose. The shaft is sunk in limestone and sinter, but 1 ton of ore has been shipped, and there are a few hundredweights of fine-grained, oxidised, 30% ore at the brace. Mr. Keand informed me that 25 tons of 35% ore have been shipped from this shaft and the adjacent trenches, but only a few tons of 20% oxidised ore can be seen at the surface now.

The trenches between Nos. 1 and 2 shafts are in "formation," but no ore is visible.

No. 3 shaft appears to be east of this formation, in mica-schist country. Very little gossan has been raised, though fragments can be picked up on the copper-grass covered surface for 1 ch. to the north, where is a trench on the Rover. In a trench alongside No. 3 shaft 18 in. of ore, dipping steeply eastwards, can be seen, and for this the shaft presumably was sunk.

Rover (M.L. 678).

Mgr., Anderson.

LOCATION, ETC.

The Rover adjoins the Mighty Atom on the north.

Its area is 5 ac.

It had been only just pegged out, when visited at the end of 1906.

One hole, 10 ft. long and 7 ft. wide, was sunk 10 ft. on this ground, before it was pegged out, by the Mighty Atom leaseholders.

ORE-BODY.

The hole exposes country veined with gossan, over a width of 8 ft. at the northern end, and, at the southern end, there are 12 in. width of solid limonite and 18 in. of cellular gossan, underlying 6 in 1 to the east 5° north. The gossan can be traced southwards to No. 3 shaft on the Mighty Atom, and northwards for 1 ch. within this lease. The crop is worthy of further attention, for, though there is little copper at the surface, rich ore is to be expected towards water level.

Mount Millicent (M.L. 663).

Mgr., McDonald.

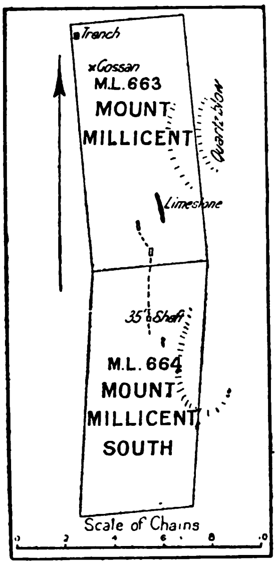
LOCATION, ETC.

Mount Millicent is ½ mile south of the Mighty Atom.

Its area is 5 ac.

DEVELOPMENT.

Only three trenches have been opened on this lease. The northernmost, 12 ft. long and 5 to 8 ft. deep, is in the north-western corner. Another, 10 ft. deep, is ½ ch. north of the centre of the southern boundary, and the third, 15 ft. long and 5 ft. deep, is 1½ ch. to the north-west of the second.



OUTPUT.

16½ tons shipped, averaging 30% opper

ORE-BODIES.

The country here is schist, but the southern workings are in the vicinity (to the west) of a crop of limestone.

The northern trench is in altered slate country, on a bunch of siliceous, oxidised, chalcocite-bearing ore, from which 2½ tons of 30% ore were bagged.

There is a small crop of very promising cupriferous gossan, worth opening up, 2 ch. south-east of this trench.

Bunches of pure cuprite were found on the surface, where is now the southernmost trench, in the northern end of which can be seen 15 in. cupreous limonite, though at the southern end there is only 9 in. width of soft ferruginous clay. In the middle of the cut 6 to 12 in. width of chalcocite-bearing carbonate-oxide ore is exposed, and is worth sinking on. The ore-body dips 10 in 1 to the east, and is bounded by schist, strongly foliated, on the west. In all, 12 tons of medium-grade ore have been shipped from this trench, and there are at grass 2 tons of ferruginous but quartz-free malachite and chalcocite tile-ore, expected to yield 30% copper. This body can be traced for ½ ch. to the north, when it probably bends round towards the central trench.

In the third trench is to be seen a 6-in. sandy, ferruginous seam, with a general north-north-west strike, but bending round towards the south-east at the southern end. Stacked alongside there is ¾ ton of siliceous oxidised ore (quartz-bearing limonite with chalcocite-enriched chalcopyrite having acicular malachite in cavities) containing between 15% and 20% copper, and 50% silica.

It is 1 ch. to the north-east of this trench that the brownish granular limestone crop, referred to, begins. The bed is 1½ ch. in length and 12 ft. wide near the centre.

Mount Millicent South (M.L. 664).

Mgr., McDonald.

LOCATION, ETC.

This adjoins the Mount Millicent on the south. It is 1 mile north-east of McDonald's Camp on Six-mile Creek, and within a few chains to the east of the Mighty Atom track.

Its area is 5 ac.

DEVELOPMENT.

The workings are in the northern part of the lease, the shaft, which is 35 ft. deep, being 3 ch. south-east of the north-western corner. An opencut, 10 ft. deep, extends for 20 ft. north of the shaft, and, 12 ft. to the south, there is a trench, 4 ft. deep. The only other openings are a few potholes 1 ch. north of the main shaft.

ORE-BODIES.

Shoads of ore are found on the surface, between the workings on this lease and those on the Mount Millicent, and, in the northern end of the opencut a 6-in. vein of ore is visible within 2 ft. 6 in. of iron-stained country, beyond which the slate is kaolinised and bleached. The hole south of the shaft is being opened in kaolinised slate alongside a band of gossan.

The shaft is sunk in kaolinised slate with iron-stained joints and very occasional bunches of copper ore. A drive to the north had just been begun, and already bunches of mixed tile-ore and crystalline malachite, as well as of mixed limonite-chalcopyrite-malachite, embedded in kaolin, were being met, warranting the continuation of the drive. There is stacked at the shaft 3 tons of chalcocite-enriched oxidised ore, likely to yield 50% copper, and very low in silica; and in addition there is 1 ton of chalcopyrite-chalcocite ore of 30% grade.

To the east of the Mount Millicent leases there is a low quartzite ridge.

Mount Bornite (M.L. 376).

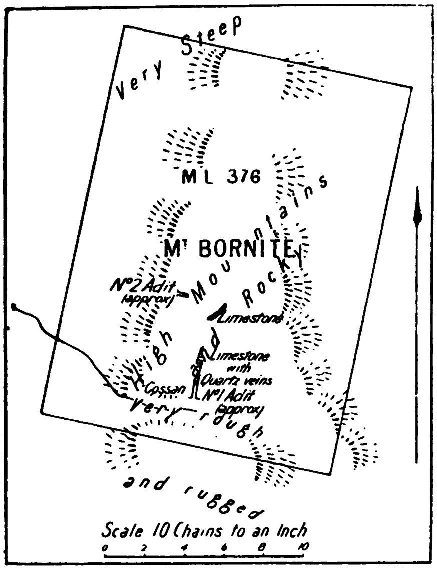
Mgr., Power.

LOCATION, ETC.

The Mount Bornite lies 1 mile south-west of the Mighty Atom, and 1½ mile north of McDonald's camp on the Mount Cuthbert track, being on the steep western slopes of the hill of the same name.

Its area is 30 ac.

Two adits have been opened on this lease: No. 1, near the southern boundary, is 100 ft. in length; and No. 2, 5 ch. to the north-north-west, is stated to be also 100 ft. long, but has now fallen in.



ORE-BODIES.

The country rocks in this vicinity comprise breccias, schists, quartzites, and limestones, having a general north and south strike.

Gossan shoads are very abundant on the steep slopes below No. 1 adit, and most of them have presumably been shed from the ferruginous crops of the limestones, in one of which is the No. 1 adit. Just above the adit it has the appearance of a siliceous gossan, up to 6 ft. in width and of some promise. This continues for a distance of 25 ft. to the north, where it gradually passes into quartz-bearing limestone, in which the amount of quartz diminishes to a negligible quantity, about 1 ch. from the adit. This bed of limestone cuts out at 2½ ch. north of the adit, but a second crop appears 1½ ch. further north. This is also veined with quartz, and contains small patches of copper ore. The crop is irregular in shape, as is not unusual in organically derived limestones. Slight copper stains were noticed still further to the north.

No. 1 adit was opened in schistose slate, but after a few feet enters and runs northwards in bluish, silky crystalline limestone. The limestone contains numerous gash veins of barren quartz and in the adit is very cavernous, the spaces being very often partly filled with gossan. The iron content of the rock is very high, and a complete chemical analysis would probably prove it to approximate to ankerite. In all, 4 tons of this gossan have been collected and stacked at the mouth of the adit. It contains much chalcopyrite, in process of conversion externally into chalcocite, together with a little malachite and tile-ore, and the proportion of silica is over 50%, the copper present being not above 15%. There is no justification for continuing the adit, but ore may be found adjacent to the limestone on the east, and a crosscut might therefore be opened in that direction.

No. 2 adit was put in to test the northern limestone crop, but failed to find the bed.

Little Wonder (M.L. 258).

Mgr., Power.

Location, Etc.

The Little Wonder lies ½ mile east from the Mighty Atom.

Its area is 5 ac.

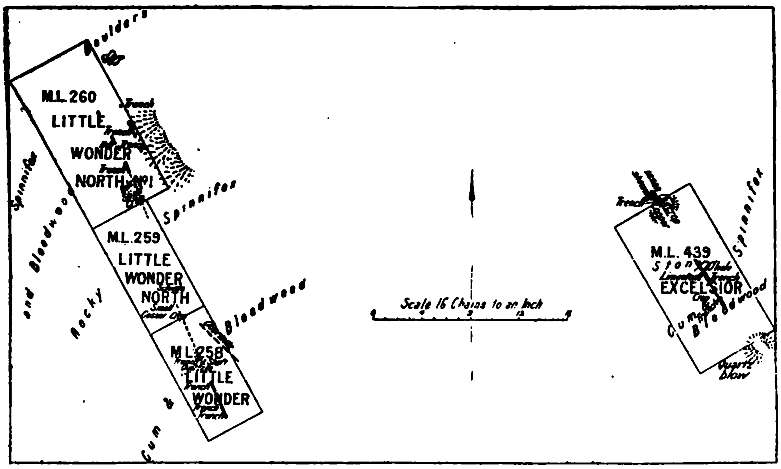
The lease is now held by the Mount Cuthbert Company, the crop having been discovered in 1896.

Development.

A trench, 20 ft. long, with a 15-ft. shaft in the centre, lies 3 ch. south-south-west from the north-eastern corner; 5 ft. to the south of it is a shallow hole; 1 ch. beyond is a trench, 50 ft. in length, but caved in; and 1 ch. beyond it is another trench, 20 ft. long and up to 6 ft. deep, but in the same state. Running north-west from the last is a trench, 30 ft. long, full of water when seen; and 10 ft. to the south are trenches, 1½ ch. long, now filled with water.

OUTPUT.

Total ... 45 tons shipped, averaging 40% copper (*fide* Mr. McKeand).



ORE-BODIES.

Mr. McKeand, the prospector, states that the ore-bodies trenched made no crop, but that shoads of native copper and cuprite, from lumps the size of a potato up to 28 lb. in weight, were abundant on the surface. It is so long since any work was done here that little or nothing can be made out of the occurrence of the ore.

The country rock is schist with converging bands of quartzite, their lack of parallelism being probably due to folding of the strata.

The northern trench and shaft now show only a 6-in. seam of ore, dipping 2 in 1 to the east. The ore is said to have been 2 ft. wide in places. Small lumps of native copper, surrounded by concentric coatings of cuprite, can be picked out of the tip.

A little chrysocolla was noticed in the limonite thrown out of the hole to the south.

Much cuprite can also be found in the north-north-west-running trench, which, though diverging from the main line of workings, is parallel to many of the quartzite crops in this vicinity.

Little Wonder North (M.L. 259).

Mgr., Power.

LOCATION, ETC.

This adjoins the Little Wonder on the north.

Its area is 5 ac.

One small trench only has been opened on this lease, and that is 1 ch. from the north-eastern corner.

Ore-bodies.

The trench is on the line worked in the No. 1 North. It exposes cupriferous gossan, worth further opening up, though probably a bunch.

Another small crop of gossan is to be seen in schist 2 ch. from the south-eastern corner. This is on the line worked in the Little Wonder.

Little Wonder North No. 1 (M.L. 260).

Mgr., Poole.

Location, Etc.

This is separated from the Little Wonder by the North (M.L. 259).

Its area is 10 ac.

Development.

A line of holes extends along the whole of the eastern side of the lease. The northernmost hole (i.), which is 10 ft. deep, is in the gully 5 ch. from the northern boundary. A trench (ii.), 30 ft. long, is 2 ch. to the south, and a 10 ft. hole (iii.), now fallen in, lies 15 ft. further south. At 1 ch. beyond it is a trench (iv.), 50 ft. long, and ½ ch. south of it is a shallow trench (v.). Besides these there are three openings on the eastern boundary line. The central one (vi.), which is 1½ ch. long and 10 ft. deep in one part, is 1 ch. east of the 50 ft. trench (v.). At 1½ ch. to the north there is a shallow trench (vii.), and 1 ch. to the south is a trench 25 ft. in length (viii.).

Output.

4 tons shipped.
1906. ... 16 ,, ,, (McKeand).

Ore-bodies.

The country rock adjacent to the ore-bodies, which would appear to consist of a number of small bunches, is schist, but at the northern end quartzite occurs to the east and limestone to the west, and further south, between the two lines of workings, there is a crop of pseudo-amygdaloidal rock (highly altered sedimentary?).

Little can be seen in the northernmost workings, but there is a little gossany carbonate ore at grass, similar to some shipped, which was found associated with "floors" of sinter.

The trench (ii.) exposes chiefly quartz rubble in mica schist, and hole (iii.) was probably on a bunch of ore.

The long trench (iv.) was presumably opened on small irregular bunches of ore in schist, but now nothing but 18 in. ferruginous formation at the northern end is visible.

Copper-bearing limonite, 18 in. across, is to be seen in trench (v.), and some native copper has been got here. A slight crop can be traced from here to the trench in the north.

The long trench (vi.) revealed irregular and ill-defined bodies of oxidised ore, of which 4 tons have been shipped.

A small bunch was found in the trench (vii.) to the north, and another occurred in that to the south, now showing only chloritic schist, with 9 in. width of siliceous gossan at the northern end.

Excelsior (M.L. 439).

Mgr., Power.

LOCATION, ETC.

The Excelsior is situated ½ mile east of the Little Wonder.

Its area is 10 ac.

Four costeans have been opened on this lease. One on the centre of the northern boundary is 20 ft. in length and 8 ft. deep; a second, 7 ch. to the south-south-east, has a hole in one end 20 ft. deep; a third, 50 ft. beyond, is 20 ft. long and 12 ft. deep near the centre; and the fourth, 1½ ch. on, is 20 ft. long and 5 ft. deep.

ORE-BODY.

This lease takes in a crop of limestone, ferruginous in parts, and showing occasional slight stains of copper, but unlikely to carry payable copper ore.

The first costean is in yellow, cherty, replaced limestone, beneath which a little copper may be found. The second costean is in limestone, with abundant dendritics but no sign of copper. The third is in white sinter (amorphous calcium carbonate) with some cherty jasper adjacent to the limestone, which here dips 3 in 1 to the east-north-east. Copper plant is abundant, but the mineral is present in only small quantities. The fourth costean is in rather gossany and sintery limestone, not worthy of further attention.

On the line of these crops, a few chains south-south-east of the lease, a blow of quartzite rises 70 ft. above the general level of the country.

Merrie Monarch (M.L. 378).

Mgr., McKeand.

LOCATION, ETC.

The Merrie Monarch is situated 2 miles north of the Mighty Atom, and really should be placed in a separate group.

Its area is 5 ac.

OUTPUT.

1906 ...	... 16 tons	bagged.
	4 ,,	shipped.

Ore-body.

Mr. McKeand states that on this lease there is a formation similar to the Mighty Atom. It is 5 ft. wide, and can be traced for about 1½ ch. in a north-north-easterly direction.

JESSIE'S DREAM GROUP.

One lease only had been taken up here in 1906.

Jessie's Dream (397).

Mgr., Reid.

Location, Etc.

The Jessie's Dream is just on the edge of the hilly country west of the Leichhardt River is 4 miles south-east by east of the Mighty Atom, and is 60 miles north-north-west of Cloncurry.

Its area is 5 ac.

Mr. McKeand informed me he had sunk a hole 15 ft.

Output.

3 tons shipped, carrying 45% copper.

Ore-body.

The outcrop is stated to be of siliceous ironstone. The pit is on a formation, 2 ft. 6 in. in width, carrying bunches of red oxide and native copper adjacent to the ironstone.

MOUNT CUTHBERT GROUP.

Eight leases are in force here, the total area being 194 acres. They extend along the eastern side of a north and south trending range, in a belt of schist, which at the Kalkadoon has a width of 5 ch. This belt requires thorough examination, and might in many parts be tested by adits, especially to the north of the leases.

The Kalkadoon workings are on a distinct zone to those on the Mount Cuthbert proper, which runs several chains to the east of the former, there forming a low crop in one place at least. There is some justification for believing that the two belts are opposite legs of a sharp anticline.

To the east of the Mount Cuthbert group there is a great development of crystalline metamorphics, with belts of porphyry, similar to the rock so characteristic of the Dobbyn group.

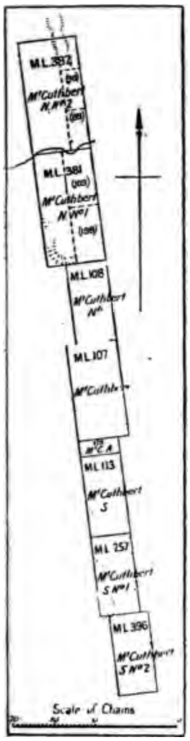
No work has been done on M.L.'s 382, 113, and 179, which are consequently omitted.

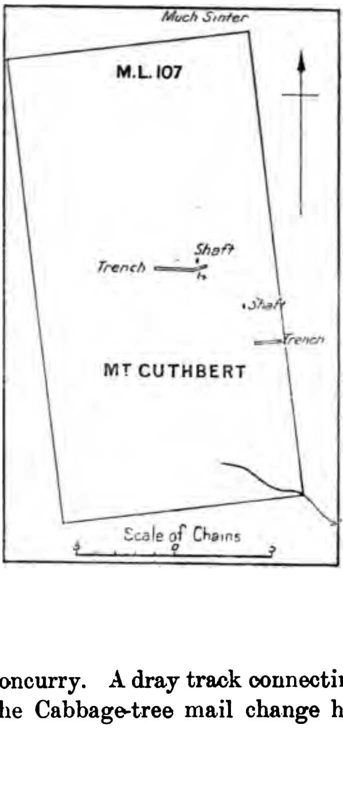
Mount Cuthbert (M.L. 107).

Mgr., Power.

LOCATION, ETC.

The Mount Cuthbert lease lies in the valley of one of the head branches of the Six-mile Creek, 19 miles south-west of Coolullah H.S., and 63 miles north-west from Cloncurry. A dray track connecting with the main Camooweal road at the Cabbage-tree mail change has now been open for some time.





The area is 30 ac.

DEVELOPMENT. *

An old hole (*a*), 10 ft. deep, lies near the eastern side, 10 ch. from the south-eastern corner; and, ½ ch. to the west-south-west, there is a trench (*b*), 10 ft. long and 4 ft. deep.

The main cutting† (*c*), 2½ ch. north-north-west of this, has a total length of 196 ft., the first section, 10 ft. deep, being 62 ft. long and running east-north-east and west-south-west, while the remainder, 5 ft. deep, runs east and west. Two holes have been sunk in the eastern arm, one (*d*) near the end being 7 ft. deep, the other, 26 ft. to the west, being 5 ft. deep.

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* From the manager's reports, published in the Press prior to 5th November, it is learnt that the new or main shaft has been sunk to a depth of 178 ft. in mineralised schist, and that 300 gall. of water per day at 106 ft. depth increased to 2,000 gall. per day at 145 ft. depth. Further a crosscut running 58 ft. east from the whip shaft at the 80-ft. level proves the following sections :—Eastern or hanging wall; 9 ft. ore; 4 ft. rock; 4 ft. ore; 2 ft. rock; 3 ft. ore; 3 ft. rock; 1 ft. ore; 6 ft. rock; 6 in. ore; 5 ft. rock; 1 ft. ore; 4 ft. 6 in. rock; 1 ft. ore; 1 ft. 6 in. rock; and 6 in. ore.

† Opened by the Chillagoe Option Co. 7 years ago.

The new whip shaft, which is 20 ft. north-north-west of the hole (*d*), was 85 ft. deep (water level?) when inspected, and cross-cuts had been opened for 40 ft. to the east, at the 40-ft. level, and for 40 ft. east-north-east and west-south-west at the 80-ft. level.

Eight men were working here on contract, but, unfortunately, the manager had business which prevented his being present at the time of my visit.

OUTPUT.

	15 tons	at grass, 20%.
	8 ,,	,, ,, 40%.
October, 1906 ...	8* ,,	shipped.

* Possibly from the Kalkadoon.

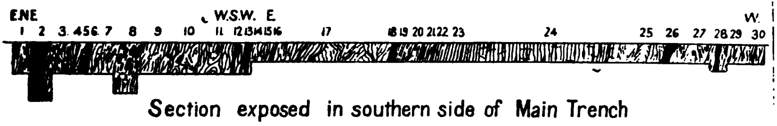
ORE-BODIES.

The main costean exposes ferruginous chloritic schists, dipping 80° to the east-south-east, in which can be seen 10 main bodies of gossany ore from 6 in. to 6 ft. thick, besides which small bunches and leaders of ore are found in the schists in five places over widths of from 5 ft. to 12 ft., while in one place slate is stained and carries bunches of ore over a width of 36 ft. (See Section.) The exposed ore at first glance might be thought to be rich in copper, owing to a thin surface film of malachite produced by leaching and evaporation. No ore that could be considered payable, under present conditions, was seen in the trench, though part of the 8 tons of tile-ore and malachite (40% copper) at grass is said to have come from the trench, as well as 15 tons of 15% carbonate ore, with limonite, tile-ore, and chalcopyrite.

A glance at the section shows that the ore-bodies fall into four groups (2, 3 and 6; 12, 14 and 16; 18, 20 and 22; and 26, 27, 28 and 29), each of which would have to be worked separately, although the workings might be connected to a central shaft. The ore-bodies are conformable, on the whole, with the bedding planes of the schist country, and there is no immediate probability of their uniting beneath the surface. They are very irregular in form, and are to be expected to cut out without warning, while others may appear, perhaps, at greater depth. Of those visible in the cut the eastern—numbered 2 on the figure—gives most promise of permanence.

That marked 6 has been worked in a 20-ft. shaft to the north, some ore from which was shipped.

That numbered 8 seems to be giving way to schist in the pothole, but the main shaft proved its permanence to 80 ft. depth. The body marked 14 opens out to 4 ft. width on the northern side of the trench, where it consists of siliceous limonite, with cuprite and a little native copper, and also bunches of tile-ore and malachite-stained kaolinised schist—the whole probably averaging 10% copper. In the western part of the bed of slate marked 24 cupriferous bands, 18 in. wide, are separated by barren rock. In the band of slate marked 20 copper, as malachite, amounts to 5%. There are 15 tons of 20% ore at grass from this costean.



Section exposed in southern side of Main Trench

MOUNT CUTHBERT

Scale 50 Ft. to an inch

10 0 10 20 30 40 50

REFERENCE.

1. 5 *ft. schist*
2. 3 *to* 5 *ft. gossany copper ore*
3. 5 *ft. schist with lenses of gossany ore*
4. 4 *ft. barren schist*
5. 1 *ft. formation*
6. 6 *to* 9 *in. ore*
7. 7 *ft. schists*
8. 6 *ft. gossan and formation*
9. 8 *ft. schist*
10. 7 *ft. kaolinised rk. veinid with ore and sinter*
11. 9 *ft. schist*
12. 6 *in. ore* (5%)
13. 3 *ft. schist with ore*
14. 6 *to* 9 *in. ore*
15. 6 *ft. schist*
16. 6 *in. gossan*
17. 30 *ft. schist*
18. 1 *ft. bunch cupriferous gossan*
19. 3 *ft. slate*
20. 5 *ft. slate with malachite* (5% *copper*)
21. 2 *ft. slate*
22. 6 *in. ore*
23. 12 *ft. slate*
24. 36 *ft. green stained kaolinised slate with bunches ore*
25. 12 *ft. schist*
26. 2 *ft. to* 9 *in. cupriferous gossan*
27. 12 *ft. schist with gossan leaders*
28. 9 *to* 18 *in. cupriferous gossan*
29. 6 *ft. schist with gossan leaders and bunches*
30. 6 *ft. schist.*

The presence of much copper-bearing limonite is evidence of the former existence of fairly dense chalcopyrite, during the oxidation of which much copper would be leached downwards. Prospecting by sinking on one of the ore-bodies and cross-cutting to test the others was therefore justifiable.

Some good ore was secured in sinking the main shaft, presumably from the band marked 16 in the section, the 40-ft. level crosscut being in 12 and 14. The crosscuts in the 80-ft. level were examined under difficulties, owing to the manager's absence, to the fact that the contractors were at work in it, and that the walls are plastered with mud. At the shaft bottom the bluish schists are slightly copper stained (surface band 16); 15 ft. west of the shaft is a 6-in. copper-bearing vein (one of the 18, 20, 22 group), and then barren schists; but 6 ft. east of the shaft is a 5-ft. band (12, 14 group) of rich carbonate ore (30%? copper), beyond which, however, there are only leaders, with, however, some black oxide or secondary sulphide (No. 8 in section) towards the face. About 8 tons of 40% ore at grass is reported to have come partly from the main shaft and partly from the long costean.

An interesting exposure of copper-stained gossan is to be seen in the old shaft (*a*) to the south-east of the above. The gossan varies from 3 ft. to 7 ft. in thickness, and has irregularly replaced schist. It contains 10% quartz and 10% schist, the remainder being dense and cellular limonite. Very little copper is showing, but it may be depended on to come in towards water level. On the surface the gossan seems to pinch out within 10 ft. to the south and within 15 ft. to the north, but the body should be prospected, as considerable enlargement may take place in depth (as at Cobar, where the country is very similar to this).

In the trench (*b*) only kaolinised schist with thin quartz veins can be seen, but between the trench and the shaft there is a crop of gossan.

Mount Cuthbert North (M.L. 108).

LOCATION, ETC.

This adjoins M.L. 107 on the north.

Its area is 20 ac.

There are no workings.

ORE-BODIES.

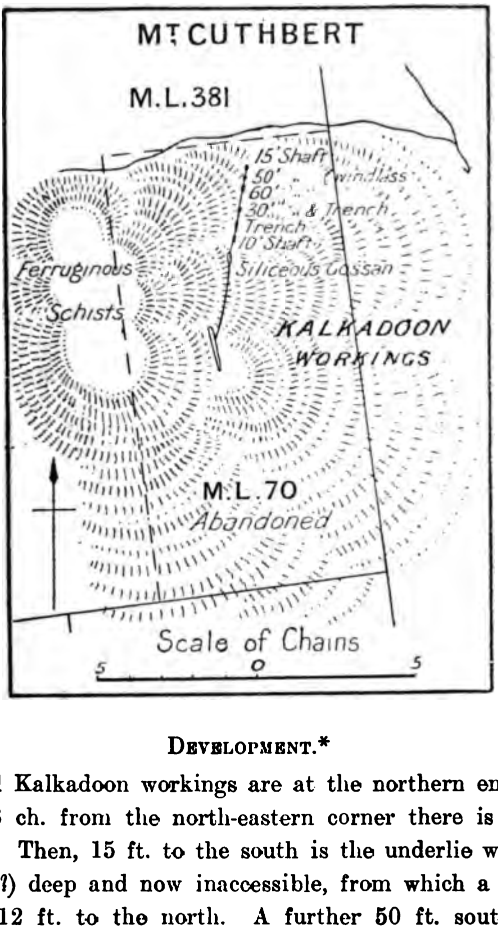
No ore-bodies were seen here, beyond a crop of quartz in the arch of the anticline between the Mount Cuthbert and Kalkadoon workings. The Mount Cuthbert belt should continue through the south-eastern corner of this lease.

Mount Cuthbert No. 1 North (M.L. 381).

LOCATION, ETC.

This adjoins M.L. 108 on the north.

Its area is 40 ac., includes forfeited M.L's. 70 and 109—the old Kalkadoon and Kalkadoon No. 1 North.



Development.*

The old Kalkadoon workings are at the northern end of the old lease. At 3 ch. from the north-eastern corner there is a shaft (*a*), 15 ft. deep. Then, 15 ft. to the south is the underlie windlass shaft (*b*), 50 ft. (?) deep and now inaccessible, from which a trench, 5 ft. deep, runs 12 ft. to the north. A further 50 ft. south of that is another inaccessible shaft (*c*), 60 ft. (?) deep, north and south of which ground seems to have been stoped out. Again, 40 ft. beyond is a 30-ft. shaft (*d*), with levels south for 20 ft., at 12 ft. from the surface, and north for 20 ft., at 15 ft. from the surface. At 15 ft. further south is a trench (*e*), 12 ft. long and 5 ft. deep; and 12 ft. to the south again is a 10-ft. pothole (*f*). No one was on the ground at the time of visit, and much difficulty was experienced in approaching the shafts, of which only one or two of the shallower ones could be descended.

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* The managers' reports published in the Press prior to 5th November, 1907, show that the No. 1 shaft at 50 ft. from the surface exposed 15 in. of massive glance, and at 61 ft. 12 in. to 18 in. of the same ore. No. 2 shaft at 85 ft. below the surface showed 18 in. of 25% ore, and at 100 ft. 6 in. of 20% ore. The southern drive from this shaft at the 75 ft. level proved 3 ft. of high-grade ore at 52 ft. from the shaft, 3 ft. of 15% to 20% ore and 2 ft. of 40% ore at 95 ft., 18 in. of 25% ore at 85 ft., and 5 ft. of 25% ore at 108 ft. from the shaft. In the western crosscut 43 ft. south of the shaft on the same level 10 ft. to 11 ft. of 10% ore was proved. The northern drive was in only 7 ft. on 4 ft. of gossan formation. The firsts at grass at the beginning of August amounted to 85 tons, and the seconds to over 100 tons.

OUTPUT.

1904	24	tons shipped (Kalkadoon).
1905	217	tons shipped (Mount Cuthbert).
1906	$178\frac{5}{20}$	tons shipped.
	200	tons bagged on the ground, believed to average 40% copper.*
	$619\frac{5}{20}$	

ORE-BODIES.

The ore-bodies occur as a succession of over-lapping lenses in a formation striking north 5° east and dipping steeply to the west. The ore bagged is reported to have been mostly glance and cuprite.

In the northern shaft (*a*) there is only 2 ft. of schist formation at the surface, and that appears to be pinching at the bottom.

The underlie shaft (*b*) shows little because of the timbering. It dips 5 in 1 to the west. Only about 5 tons of seconds (gossan and stained country) carrying 5% copper are at grass.

The shaft (*c*) also underlies, and is flatter towards the bottom. There is probably 3% copper in the tip at this shaft. The 8 tons of ore, at grass ready for sorting, consists of a mixture of gossan and malachite, limonite, with disseminated cuprite and quartz (original and drusy in cavities), chalcopyrite, pyrite (mosaic in limonite), and glance, the last, which is to be separated, carrying 35% copper.

In the shaft (*d*) beautiful, soft, foliated schist can be seen. The ore raised from the bottom of the shaft is an intimate mixture of chalcocite, malachite, and tile-ore. Most of that at the brace is quartz-bearing limonite and cuprite (with crystalline malachite in cracks), cementing angular quartz. A little quartz also occurs in drusy form in cavities.

In the cut 10 ft. from the shaft (*d*) the lode (malachite bearing) has pinched to 9 in., and the average in the shaft itself is 6 in. In the southern level of the shaft there is a formation, 6 to 12 in. thick, in which siliceous and ferruginous ores occur, in over-lapping lenticular bunches, not more than 6 in. thick. The country rock is dark chloritic schist, much slickensided internally, and altered east of the lode to yellow clay. At the shaft bottom, south end, a 2-ft. bunch of chalcopyrite-glance ore is exposed, but, at the north end, the body has given place to iron and copper stains over a width of 18 in. of quartz-veined schist. The chlorite schist here is slickensided internally, west of the lode, for 2 ft. as above, but the eastern country is more gritty and less altered, though copper-stained for 12 in. from the lode. This shaft should be continued, as there is a possibility of a large ore-body being struck here. The ore at the brace is very siliceous, being really a quartz breccia, cemented by limonite, with secondary silica in cavities and with strong stains of manganese dioxide, as well as malachite and chrysocolla; there is also some green-stained kaolinised schist. Much 10% ore could be culled from the tip, and 40 tons is bagged at grass, the "seconds" (quartz-bearing limonite) amounting to 25 tons, probably carrying 10% copper.

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* Reason given that stacked at shaft is that it was now too late to carry to Normanton, and that it was impossible to secure camels.

Only a few inches of ore are showing at the northern end of the trench (*e*), but there is 12 in. at the southern end. The ore here includes small angular quartz fragments cemented by quartz-bearing limonite (some of it stained by chrysocolla) and with malachite in open spaces.

The shaft (*f*) is being sunk alongside 6 to 18 in. siliceous limonite, in malachite-stained kaolin.

The siliceous gossan, containing some copper, widens out south of the last hole, being 20 ft. across ½ ch. distant from it, where it unites with or runs for a chain alongside an 18-ft. blow of silicified limonite or yellow jasper. The boulders, over a further width of 20 ft. east of the blow, have probably fallen from the crop.

The large blow, which is distinctly banded and contains white quartz, crops for ½ ch. to the north-north-west of the junction.

Mount Cuthbert 1 South (M.L. 257).

LOCATION, ETC.

This adjoins M.L. 113 on the south.

Its area is 20 ac.

The workings comprise a 35-ft. shaft (*a*), in about the centre of the lease, and now inaccessible; a trench (*b*), 1½ ch. to the north; and trenches and holes to the south. This work was done by tributors during 1905.

OUTPUT.

40 tons, yielding 20 to 35% copper.

ORE-BODIES.

A siliceous limonite crop runs south from the northern trench to the main shaft, in which 3 ft. of gossan can be seen going down vertically. The ore now at grass, amounting to ½ ton, consists of siliceous gossan, with chalcopyrite altering into glance—copper 5%—but some 40 tons are said to have been shipped for yields of from 20% to 35% copper.

A 6-in. siliceous gossan leader on an east and west joint has been trenched for 2 ch. from the shaft, and lead to the discovery of a small bunch of ore.

The ore-body seems to have pitched to the south at the shaft, for it was not found in the southern trenches and holes.

Mount Cuthbert No. 2 South (M.L. 396).

LOCATION, ETC.

Adjoining M.L. 257 on the south.

Its area is 20 ac.

The one shaft, 25 ft. deep, near the northern boundary, was sunk early in 1906.

ORE-BODY.

The shaft is sunk in kaolinised schist, with abundant sintery magnesite and scattered masses of ore, consisting of kaolinised schist with quartz, limonite, malachite, and chrysocolla, exhibiting small quantities of the original pyrite. The copper content of the 3 tons at grass probably does not exceed 5%.

COOLULLAH.

The Coolullah district includes those holdings to the west of the station of that name, on the Leichhardt River, lying north of the Leichhardt River groups. These mines are all included within the catchment areas of Copper Mine and St. Paul's Creeks, a region of old land forms, approaching the peneplain stage.

WARWICK CASTLE GROUP.

The group lies about 3 miles south-west of Von Bremen's camp, on the head waters of St. Paul's Creek, 69 miles north-west of Cloncurry.

The ore-bodies are overlapping lenses of quartzite on a north-north-west line, and traceable for 1½ mile from the Castle to St. Paul's Creek. Beyond the creek the crops trend northwards, and run 1½ mile to the west of Von Bremen's Camp. The quartzite is broken and the schists are crushed in a similar manner to those at Duck Creek.

The timber is as usual thin and stunted box and bloodwood.

The Warwick Castle No. 1 North (M.L. 645), No. 2 North (M.L. 646), No. 3 North (M.L. 643), and the Evelyn (M.L. 644) are here omitted as not yet worked.

Warwick Castle (M.L. 314).

Location, Etc.

The Warwick Castle is at the head of St. Paul's Creek, 6 miles north-north-west from Mount Cuthbert, and 12 miles south-west from the Dobbyn.

Its area is 20 ac.

There were no workings at the time of my visit.

Ore-body.

The main crop is formed of green-stained, quartz-veined, schistose quartzite, a chain in length, 12 ft. in width and rising 20 ft. above the general slope of the ridge. The quartzite can be traced for 10 ch. south-south-east of the main "castle" and for 5 ch. to the north-north-west, where it forms a second but smaller blow. It is granular in parts, but much of it has the appearance of crystalline quartz. It has in some places been shattered and crushed and is then ferruginous, and on the whole is similar to the Tharsis and Chinaman crops at Duck Creek. No payable ore is in sight, but one or two small bunches of cellular malachite-bearing tile-ore were seen. It is therefore unlikely that, if sunk upon, the ore will average over 5% copper even after the rejection of 50% quartz. The country is schistose slate, with quartz lenses plentifully developed near the quartzite.

Kenilworth (Extended M.C. ?).

LOCATION, ETC.

The Kenilworth is ½ mile north-east from M.L. 314, and about 10 ch. east of the Warwick Castle line.

This is four men's ground—taken up as a block on the Warwick Castle line, for which there is no present justification.

One pothole has been sunk.

ORE-BODY.

In the pothole there is 6 in. to 2 ft. of quartz and gossan with some chalcopyrite, altering to glance, and also malachite but very siliceous. This is probably a bunch less than a chain in length.

The country rock is slaty schist.

Louisa (M.L. 643).

LOCATION, ETC.

The Louisa is on the northern side of the head of St. Paul's Creek, 1½ mile from the Warwick Castle.

Its area is 10 ac.

Only surface scratching has yet been done, the ground having been just pegged out.

ORE-BODIES.

Small patches of gossany ore are scattered over the surface with earthy calcareous sinter and quartz, the country rock being ferruginous schist.

Evelyn (M.L. 644).

LOCATION, ETC.

The Evelyn is on the southern side of the head of St. Paul's Creek, 1¼ mile north of the Warwick Castle.

Its area is 20 ac.

No work has been done and the ground was not inspected by me.

VON BREMEN'S GROUP.

This group is in the vicinity of Von Bremen's and Hare's camps, at the head of St. Paul's Creek, about 70 miles north-west of Cloncurry.

Most of the mines are of no economic importance, but several of them offer interesting geological studies.

Mount Stanley No. 1 South (M.L. 606), Emerald (M.C. 357) and Emerald No. 2 South (M.C. 367), Mount Cherry No. 1 North (M.C. 363) are not worthy of separate mention.

Isabella (M.C. 360).

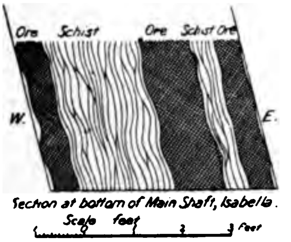
LOCATION, ETC.

The Isabella, originally P.A. 257, is ¼ mile west of Von Bremen's camp on St. Paul's Creek, 71 miles north-west-by-north of Cloncurry.

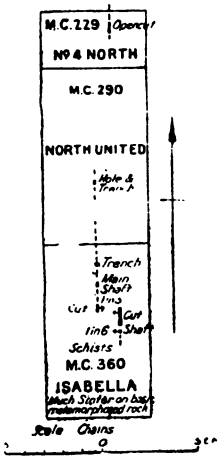
Its area is 600 ft. × 350 ft.

DEVELOPMENT.

The workings consist of, on the western lode, a trench (*a*), 1 ch. from the northern boundary, a main shaft (*b*), 45 ft. deep, a chain to the south, and a cut (*c*), a chain further south; on the eastern lode a cut (*d*), 60 ft. long × 10 to 12 ft. deep, 1 ch. east of the cut (*c*), and a shaft (*e*), 25 ft. deep, 15 ft. to the south.



Section at bottom of Main Shaft, Isabella.



OUTPUT.

	14 tons	shipped	25 to 26½%
	(15 ,,	at grass)	
1906 ...	9 ,,	shipped.	

ORE-BODIES.

The two ore-bodies, worked on this claim, were most likely formed in shear-zones by uprising solutions. They are parallel, one chain apart, and dip towards one another at steep angles.

In the northern trench, on the western lode, 2 ft. 3 in. gossany carbonate ore, with at least 10% copper, is exposed in the northern end, but there is only formation at the south end. The cap of the lode, averaging 9 in. in thickness, has, however, been traced southwards to the main shaft.

The main shaft shows no defined lode, but an internally slickensided schist formation, dipping 1 in 3 to the east, and similar to those at Duck Creek, in which lie bodies of ore. The chloritic schist country is greatly crushed near the formation, and all faces are brightly slickensided. This is indicative of extensive shearing, and there is consequently considerable promise of the ore formation being permanent.

Most of the ore consists of chalcopyrite, altering throughout into limonite and glance, with some patches of ferruginous tile-ore and a little malachite. The 4 tons of ore at grass, secured from the last 15 ft. of sinking, may be expected to yield 40% copper. The cellular nature of some of the surface ore signifies that at water-level chalcopyrite is to be expected.

Sinking is, therefore, to be continued, and further prospecting should be carried out by cross-cutting.

In the southern cut (*c*) the schist, over a width of 3 ft., is slightly cupriferous and 2 cwt. of siliceous limonite, carrying 10% copper, has been paddocked.

The cut (*d*), on the eastern lode, shows that the ore is in the form of a succession of lenses, up to 12 in. thick, dipping 1 in 6 to the west. The ore shipped, 2½ tons, yielded 26% copper; and the 8½ tons (chalcopyrite and limonite with interlacing malachite) lying at grass, probably carries 30% copper.

The eastern shaft (*e*) is also sunk in a schist formation, the width of the shaft, with bunches of quartz and poor ore. The formation can be traced for a chain to the south.

The immediate country rock is a crushed chloritic schist, but to the south-east is basic igneous, highly metamorphosed but not schistose.

Isabella North United (M.C. 290).

LOCATION, ETC.

This adjoins M.C. 360 on the north.

Its area is 600 ft. × 350 ft.

One 10 ft. hole and a trench are 3 ch. north of the southern boundary, and besides there is a cut on the southern boundary.

OUTPUT.

3 tons shipped, 25% copper.

ORE-BODY.

The hole is on the line of strike of the western lode in the Isabella, though the crop is not continuous. Shattered quartz, cemented by limonite carrying chalcopyrite and stained slightly by malachite, was found in the hole, but no payable ore is to be seen.

The cut on the southern boundary appears to be on a separate bunch lying to the west of the above. The ore raised from it amounted to 3 tons.

Isabella No. 4 North (M.C. 229).

LOCATION, ETC.

This adjoins M.C. 290 on the north.

Its area is 200 ft. × 350 ft.

There is one opencut 25 ft. long and 15 ft. deep.

OUTPUT.

8 tons shipped, 32%
4 ,, at grass, 30% (?)

ORE-BODY.

The opencut is on the line of strike of the eastern body found in the Isabella. The crop, which extends due north for 2 ch. north of the cut, is made up chiefly of iron-stained quartz. The schist formation, which in the northern end of the cut is 9 in. to 2 ft. wide, carries bunches of quartz, chalcopyrite, and secondary oxides and sulphides, stained by malachite. Of the ore raised 3 tons of "firsts" from which all quartz has been separated and which is expected to carry 30% copper, remain at grass. The "seconds" at the brace amounting to 2 tons may carry 20% copper with considerable silica.

The ore-body is in a belt of ferruginous schist, in which other lenticular bodies are to be counted on.

Mount Hare (M.L. 642).

LOCATION, ETC.

Mount Hare lies 1½ mile north-north-west of the Warwick Castle, and 2 miles west-north-west of Bremer's Camp on St. Paul's Creek.

Its area is 10 acres.

No work has yet been done, and the lease was not visited.

ORE-BODY.

It is reported that the crop consists of quartzite, stained green by carbonate of copper.

Hare's Excelsior (M.L. ?).

LOCATION, ETC.

Hare's Excelsior lies 1 mile south-west of his camp, on Hare's Creek, one of the upper branches of St. Paul's Creek, about midway between the Dobbyn freeholds and Warwick Castle leases.

One shaft (*a*) 8 ft. deep, a pothole (*b*) 20 ft. to the west, and a trench (*c*) 30 ft. to the north of the latter are all the workings. No work was going on at time of visit, but it was proposed shortly to let a tribute to two men.

ORE-BODIES.

The shaft was opened in gossany quartz at the surface, overlying 3 ft. of sintery formation, below which is an 18-in. vertical quartz reef, striking east and west. It carries, say, 10% of limonite with strong copper stains.

One or two lumps of ore seen exhibit original chalcopyrite, in process of oxidation into glance and limonite.

The country rock, a dark gritty slate striking north and south, is crushed for 6 in. from the lode, and contains quartz leaders.

The pothole (*b*) is on the same reef, here apparently contracting in depth and containing no visible pay ore, but worth prospecting.

The northern pothole (*c*) may possibly be on a faulted portion of the same lode. It reveals only 6 in. of quartz, but granular calcite occurs in the crop a few feet to the west.

A parallel crop of gossany quartz occurs 1 ch. east-south-east of the main shaft, and the schists, 2 ch. beyond, are stained with copper.

Generally speaking, there is very little to be seen here, but some work might be carried out in search of copper ore beneath the more gossany crops.

Mount Stanley (M.L. 584).

LOCATION, ETC.

Mount Stanley is 2 miles west-north-west from Von Bremen's Camp, at the head of St. Paul's Creek.

Its area is 20 ac. The lease was not visited.

One shaft has been sunk 8 ft.

There are reported to be three lodes.*

Violet United (M.C. 317).

LOCATION, ETC.

The Violet United is 1 mile south-east of Hare's camp on Hare's Creek, one of the upper branches of St. Paul's Creek.

This is ten men's ground—2,000 ft. × 350 ft.

One hole, 6 ft. deep, is near the north-western end.

ORE-BODIES.

The ore-bodies occurring in the sedimentaries here may be presumed to, at least, owe their origin to the intrusion of the granite, even if the heavy metals did not directly emanate from the solidifying magma.

A few blocks, one foot in diameter, of cupriferous, cellular, gossan were found in the pothole, but nothing in the nature of a lode can be seen. The country rock is highly altered, siliceous slate, overlying and intruded by pink felspar granite, cropping west and south of the claim.

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* A sample of ore, consisting of iron- and copper- stained schist and quartz, taken from over a width of 9 ft. at the bottom of a 60 ft. shaft by Mr. W. A. Gordon, has been assayed for the following result (Government Analyst):—

Copper	=	2·2%
Gold	=	trace
Silver	=	1 dwt. per ton.

Several small masses of ore, of no continuation and known to the miners as " squibs," occur in the western part of the claim and there are some leaders near the centre, on which it is proposed to sink a shaft.

There is nothing here to warrant further work.

Mount Brown (M.L. 652).

LOCATION, ETC.

Mount Brown is 1 mile south-east of Hare's camp, upper St. Paul's Creek.

Its area is 5 ac.

No work has yet been done.

ORE-BODIES.

No body has been exposed, though the silicified country, proved cupriferous in the No. 1 North, continues through this lease. The silicified and crushed quartzites are here 30 ft. wide, but contain only stains of copper ore.

Mount Brown No. 1 North (M.L. 653).

LOCATION, ETC.

This adjoins M.L. 652 on the north-north-west and the Violet on the south-east.

Its area is 5 ac.

There are no workings.

ORE-BODIES.

The ore-bodies occur in a ferruginous and siliceous belt of altered sediments, adjacent to an intrusive mass of granite. Nothing payable or even worth prospecting has yet been proved here, but the occurrence is full of significance geologically.

A crop of silicified limonite, 30 ft. long and 10 ft. wide, occurs on the southern side of the knoll of silicificous slates in the centre of this lease. It carries stains of copper, which metal may have been introduced after the intrusion of the granite.

Mount Brown No. 1 South (M.L. 654).

LOCATION, ETC.

This adjoins M.L. 652 on the south-south-east.

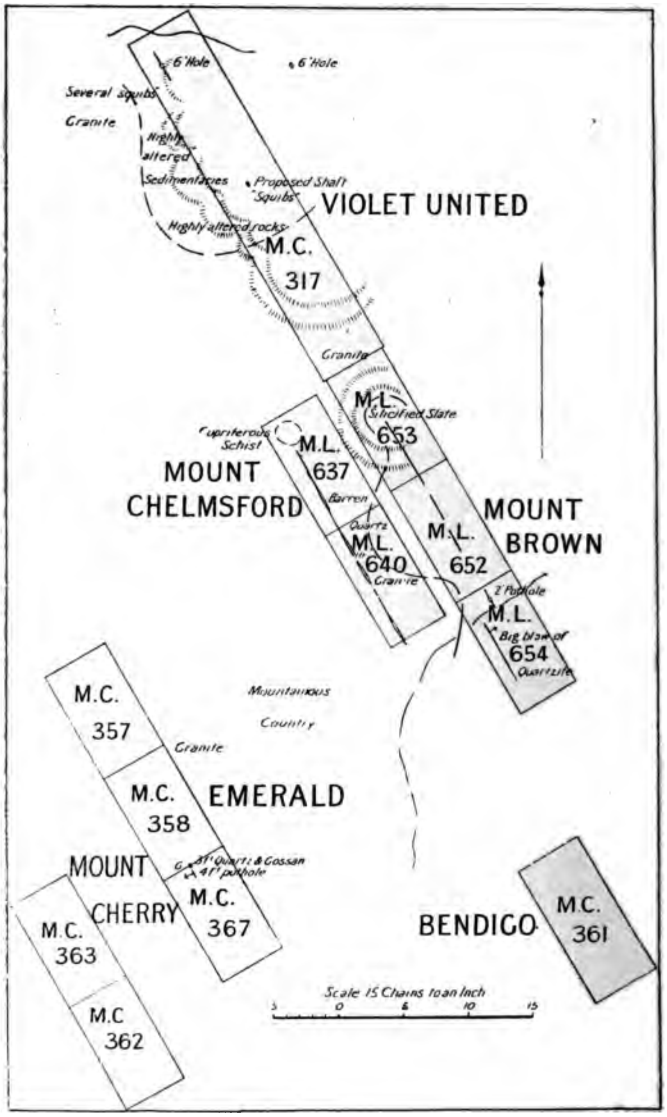
Its area is 5 ac.

One pothole, 2 ft. deep, is near the boundary of M.L. 652.

ORE-BODIES.

Blocks of limonite, with original chalcopyrite altering into glance and containing some tile ore, have been taken from the pothole, some feet east of the line of strike of the Mount Brown siliceous crop, but no lode is exposed.

Across the creek to the south is a big blow of white quartzite, probably a continuation of the Mount Brown crop. This, it is reported, can be followed for several miles to the south.



Mount Stuart (M.C. 326).

LOCATION, ETC.

Mount Stuart lies 1½ mile north-east of Mount Brown.

Its area is 600 ft. × 350 ft.

There is one hole, 12 ft. deep.

This claim is reported to be in similar country to that at the Violet, striking north-west and south-east.

Mount Chelmsford (M.L. 637).

LOCATION, ETC.

Mount Chelmsford is to the west-south-west of, and separated by one chain from, M.L. 653.

Its area is 5 ac.

No work has been done.

ORE-BODIES.

The ore-bodies comprise blows of quartzite, forming a line parallel to the Mount Brown crop. The quartzite has been shattered in one or two places, and has there been rendered cupriferous to a very slight extent. It was at first thought that these blows of quartzite indicated eruptive after effects of the cooling granitic magma, but the discovery of a few patches of schist in connection with them proves conclusively that they are older than the igneous rock, which has been able to almost completely absorb the comparatively basic schists, leaving the quartzites untouched. The small quantities of copper ores, in schist and quartzite, may, however, have been given off pneumatically from the granite.

The blows of pink quartzite are several feet thick, but contain copper ore in only one or two places, where shattered. At the northern end of the lease there is a small area of dark, schistose, somewhat siliceous, slaty rock, an inclusion of the sedimentaries in granite. A little copper occurs in the more schistose parts, the quartz, gossan, and crushed rock, on the north-western boundary of the lease, averaging between 3 ft. and 6 ft. This is the only part of the crop worth trenching even.

Mount Chelmsford No. 1 South (M.C. 294).

LOCATION, ETC.

This adjoins M.L. 637 on the south-east.

Its area is 400 ft. × 350 ft.

There are no workings.

ORE-BODIES.

Blows of pink quartzite occur here in granite, but very little copper ore can be seen, and that only where the quartzite is shattered.

Emerald No. 1 South (M.C. 358).

LOCATION, ETC.

The Emerald claims have been taken up on a line parallel to the Mount Chelmsford and ¼ mile to the south-west.

The area of the No. 1 South is 600 ft. × 350 ft.

A pothole 4 ft. deep is on the south-eastern boundary.

ORE-BODIES.

The ore-bodies in the Emerald claims occur both in schist and granite. They would appear to have been formed in the schist, and now occur partly in the granite, owing to the absorption of the original country rock by the molten intrusive magma, as at Mount Chelmsford. They are of little economic value, but of considerable geological interest.

In the northern portion of the No. 1 South quartz occurs in a schist belt a chain wide, presumably near the base of a trough, for there is granite on both sides.

At the southern end of the claim quartz and gossan, 3 ft. wide, dips 80° westwards in granite, into which pass numerous leaders and droppers from the lode. A few hundredweight of copper ore (limonite with chalcopyrite and secondary sulphides) have been paddocked. Nothing payable has yet been proved here, though traces of lode material have been found over the whole length of the three claims.

Mount Cherry (M.C. 362).

LOCATION, ETC.

Mount Cherry is 6 ch. south-west of the Emerald.

Its area is 600 ft. x 350 ft.

One pothole has been sunk 3 ft. in the centre of the claim.

ORE-BODIES.

The ore, of which only a few hundredweight have been paddocked, occurs in schistose rock, included in granite. Nothing payable has yet been found here.

The granite area, to the east of the Mount Cherry claims, contains many apparent "segregation" patches, which are really partly digested inclusions of the more basic sedimentaries taken up by the fluid magma.

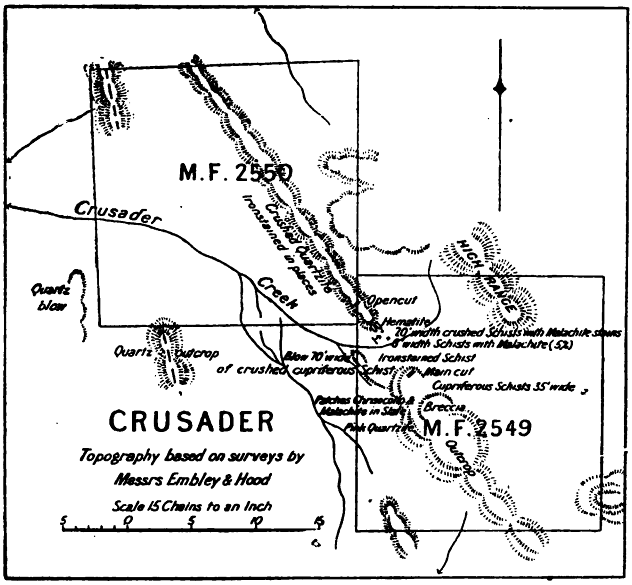
CRUSADER GROUP.

The Crusader freeholds are located on the Coolullah run, east of Coppermine Creek and 7 miles westerly from Coolullah head station. They have lately been resurveyed and remarked, but at the time of my visit the boundaries were not known and my inspection was therefore carried out under some uncertainty.

Several leases and claims have been taken up in the vicinity, and one, the Carpentaria (M.L. 566) formerly the Northerner, is within a few miles of Coolullah head station.

The Crusader ore-bodies occur in a belt of schist and crushed quartzite, striking north-north-west.

From any eminence a number of quartzite crops can be seen in this locality, most of the ridges being, in fact, due to them. Their divergence in strike is particularly noticeable and this irregularity is probably due to contortion of the strata and does not indicate that the quartzites make the sites of fissures.


M.F. 2550
Crusader
Crushed Quartzite
Ironstained in places
Creek
HIGH RANGE
Opencut
Hematite
20' width crushed Schists with Malachite stains
6' width Schists with Malachite (52)
Quartz blow
Quartz Outcrop
Blow 70' wide
of crushed cupriferous Schist
Ironstained Schist
Main cut
Cupriferous Schists 35' wide
Patches Chrysocolla & Malachite in Slate
Breccia
Pink Quartzite
M.F. 2549
Outcrop
CRUSADER
Topography based on surveys by
Messrs Embley & Hood
Scale 15 Chains to an Inch
5 0 5 10 15

LITERATURE.

(2) Mr. Jack reported thus:

> A mile further, the *Crusader Copper Lode* (12 miles from Walsh's camp) stands up boldly above the surrounding country. Its matrix is quartz, which can be seen from a distance to be stained green with copper ore. The lode runs north 40 degrees west and is about 50 feet wide. On the surface and sides are large masses of copper ore and gossan. I broke out some fair samples of red oxide, malachite, and grey ore. The ore is more intimately mixed with silica than is usual in this district. A cutting has been driven into the N.E. side of the lode for a distance of about 15 feet. Besides copper ore, the cutting shows a large quantity of specular iron in a matrix of pale green talc. The association, in the same lode, of copper ore and ironstone, is suggestive, considering the number of enormous outcrops of ironstone which occur in the district.

(7) Mr. Rutherford says of the Crusader:

> The freehold includes the northern end of a prominent quartzite range, which runs in a north and south direction over a large extent of country. The quartzite is iron-stained and associated with quartz, and shows patches stained green with copper salts. A cutting 25′ into the west side of the hill shows talc schist impregnated with iron and associated with copper carbonate. Some good bits of red oxide can be picked out of the mullock heap on the surface, but no body of ore could be seen in the trench and the stained ground could not be traced on the surface farther than a few feet. Following the quartzite to the north, across a small creek, about 100 yards, a second trench shows iron-stained slate, showing a few copper stains. Beyond this the quartzite continues hard and barren.

Crusader (M.F. 2549).

LOCATION, ETC.

This freehold is located at the head of Crusader Creek, a branch of Soda Creek, which empties into Coppermine Creek, a tributary of the Leichhardt River.

The area of the block is 40 acres approximately. It was taken up under the old 1874 Mining Act as a mineral selection, and became freehold by the observance of the conditions.

DEVELOPMENT.

The northern cut is on the crest of the ridge, just on the boundary of M.F. 2550. It is 18 ft. long, and in the north-eastern end there is a pothole 8 ft. deep.

The southern cut, on the north-eastern side of the ridge, 9 ch. south-east of the north-western corner, is 20 ft. long, and at the south-western end is 8 ft. deep.

ORE-BODIES.

Barren quartzite forms the greater part of the crop in the south of M.F. 2549, but in the north-western part of the block the quartzite gives out to a great extent, and the schists there are impregnated and stained over considerable widths by malachite.

The northern cut exposes only silicified country veined with limonite, and the hillock to the north-north-west is built of crushed quartzite, iron-stained in places. A thin vein of carbonate ore has lately been brought to light in shallow potholes just to the south of the trench.

Two chains south-east of the northern cut the schistose country has been replaced, over a width of 4 ft. and a length of 30 ft., by granular hæmatite and magnetite, carrying malachite in the interstices between crystals. A little siliceous limonite also occurs here, but the crop is, on the whole, very disappointing from a copper standpoint. The crushed schists, just to the south of the hæmatite lens, are stained by malachite over a width of 20 ft., but the copper present on the whole is little more than a trace.

In the gully, half a chain beyond the last, fairly rich malachite ore occurs in schist, over a width of 6 ft.—the average contents being perhaps 5%. This should be opened up by trenching.

South of the gully the iron-stained schists continue for 2 chains, where they have suffered crushing to some extent, and form a blow about 70 ft. wide painted profusely with surface carbonate and in the more crushed parts containing some bunches of medium grade (10%) ore.

The main southern cut is one chain beyond, on the north-eastern side of the crop, here 35 ft. wide and consisting of ferruginous schists with bunches of copper ore—dipping 4 in 1 to the north-east. The cut proves the schists to have been almost completely sericitised, with the development of plumose aggregates of sericite plates. Crystallised and granular hæmatite and magnetite (both strongly magnetic), introduced subsequently to the sericitisation of the rock, are very abundant and cellular limonite casts of original pyrite are also plentiful. The whole face of the cut is stained green, but only on the exterior, and there are a few bunches of fair grade (20%) earthy carbonate. My sample (38/B), taken from 16 ft. width on the south-eastern side of the cut, was examined at leisure, and found to consist of completely decomposed schist, stained a faint green by silicate and carbonate of copper. Some of the schist is cellular and iron-stained, owing to leaching out of pyrite. Only one small fragment of rich malachite and glance ore was included, and this showed a little native copper. The following is the result of analysis (Government Analyst):—

Gold ... ... = nil
Silver ... ... = nil
Copper ... ... = 5·3%

The ore from the cut was stacked alongside it, but the heap has evidently been picked over, and only the poorer material, amounting to 3 tons, now remains. Crystalline radiating malachite occurs here in plumose sericite (?), and the ore contains 10% copper and 50% iron.

About 2 ch. south of this trench the crop is formed of a breccia of quartz, cemented by silicified limonite, the whole gradually passing first into cellular gossany quartz and then into pink quartzite, within 5 ch. of the cut. It would be worth while opening an adit on the north-eastern side of the gossany quartz crop and 40 ft. below the cap.

Some small cupriferous areas were noticed 2 ch. south-west of this portion of the main crop—the copper occurring as silicate and carbonate encrusting the sides of cracks in the siliceous slate country.

Crusader (M.F. 2550).

LOCATION, ETC.

This adjoins M.F. 2549 on the north-western corner.

Its area is 40 ac.

ORE-BODIES.

Little copper was seen on the northern freehold though the crushed quartzites traverse it as a bold ridge and continue for nearly a mile.

The cupriferous country exposed in the northern trench on M.F. 2549 must at least enter this. However, only a few chains to the north-west, crushed quartzites occupy the whole of the ridge, and preclude any likelihood of extensive ore-bodies being found on it.

Mount Leonard (M.L. 563).

LOCATION, ETC.

Mount Leonard is ¼ mile west of M.F. 2549.

Its area is 20 ac.

No work has been done.

ORE-BODY.

There is here a north-and-south striking band of quartzite, 2 ft. to 10 ft. in width. It is generally iron-stained, and in parts has the structure of a crush zone.

Orphan (M.L. 667).

LOCATION, ETC.

The Orphan is one mile due east of Alchin's Camp, which is a mile east of the Dobbyn freehold.

Its area is 10 acres.

One pothole has been sunk at the end of the ridge in the southern part of the lease.

ORE-BODIES.

In present state of development it is impossible to generalise as to the nature of the ore-body, beyond stating that the crop is similar to the Chinaman, and may be part of a crush-zone. In about the centre of the lease there is a north-north-west striking quartzite crop of the Chinaman type, but rather more gossany than the original at Duck Creek. The width is 12 ft. and the total length of crop is 6½ chains, of which 1½ ch. at the northern end is very gossany and worth testing for low grade copper ores. The more barren part of the crop forms a low ridge, beyond which gossan and quartz rubble on the surface have induced prospecting, with the result that a ½ ton bunch of ore was located in a shallow hole. The ore, as bagged, consists of rather impure malachite with a little glance, the copper amounting to between 20 and 25%. It could however be picked much cleaner than this, with little trouble. The seconds at grass are very high in silica but should yield 5% copper.

The country rock is schist and the altered porphyry so characteristic of this district.

Three Jacks (M.C.).

LOCATION, ETC.

The Three Jacks claim is ¼ mile south of M.F. 2550.

It includes 3 men's ground, 350 ft. × 600 ft.

The workings comprise a shaft 10 ft. deep and a hole 2 ch. to the north-east.

OUTPUT.

1906 ... 3½ tons bagged, containing 25 % copper.

ORE-BODY.

There is no defined lode, the ore occurring as bunches, up to 12 in. thick, in chloritic schist. The bunches, however, are connected by a vertical 2 in. formation, running east 35° north. The ore from here and adjacent patches has been bagged and amounts to 3½ tons—25% copper expected.

Flower (M.C. ?).

LOCATION, ETC.

The Flower is 1 mile south-south-west of the Crusader.

The trench opened is 20 ft. long, 6 ft. wide, and up to 12 ft. deep—and is now partly filled in.

ORE-BODY.

The crop is composed of quartzite, dipping 1 in 10 vertical to the north 25° east. In the trench 18 in. of gossany quartz is visible. Of the ore raised 1 ton has been bagged, and 1 ton lies unpicked at the surface. The latter is chiefly granular limonite, with only stains of carbonates on the joints, and containing not much more than 2% copper. The bagged ore is much richer in malachite (as acicular crystals in tile-ore) the copper reaching 20%, but it is very siliceous.

Porphyry occurs in the vicinity.

Clinker (M.L. 565).

LOCATION, ETC.

The Clinker lies ¼ mile south of M.F. 2550.

Its area is 20 ac.

There is one trench, 6 ft. long.

ORE-BODIES.

This lease is traversed in a direction east 10° south by a crop of quartzite, showing bunches of fairly rich carbonates in places.

In the trench there is 2 ft. of quartz-bearing limonite on the foot-wall adjacent to 4 ft. barren white quartz. The gossan extends on the surface, for a distance of 1½ ch., and may be confidently expected to carry bunches of carbonates beneath the surface.

Other quartzite crops in this vicinity are not parallel to the above, and their divergence is to be explained by folding of the strata in which they occur.

Mount Sparklet (M.L. 564).

LOCATION, ETC.

Mount Sparklet is ½ mile south-east of M.F. 2550.

Its area is 29 ac.

No work has been done here.

ORE-BODIES.

The main quartzite crops lie on a line striking east 10° north. They are from ½ to 1 ch. in length and separated by blanks of from ¼ to 1 ch., in which no crop is to be seen. The separate crops are up to 8 ft. in width, and some of them stand 10 ft. above the ground, the rather ferruginous over widths of 2 ft., and, where crushed or schistose, general effect being that of a ruined wall. The quartzite is in parts

FIG. 24.—QUARTZITE CROPS, MOUNT SPARKLET. [*L. C. B., photo.*

contains bunches of carbonate—the largest 10 ft. long and 2 ft. wide. It is thus similar to the Chinaman, though more ferruginous, and would appear to be due to concentration of original silica along crush-zones, formed during the folding of the strata.

The quartzite resembles that at the Chinaman in having at intervals a schistose structure, where it is rather more ferruginous. Bunches—the largest 10 ft. long and 2 ft. wide—of siliceous carbonate ore, say 10% copper, occur in the crushed or schistose portions.

A smaller parallel crop lies 5 ch. south of the above, and contains rich patches of ore a few pounds in weight.

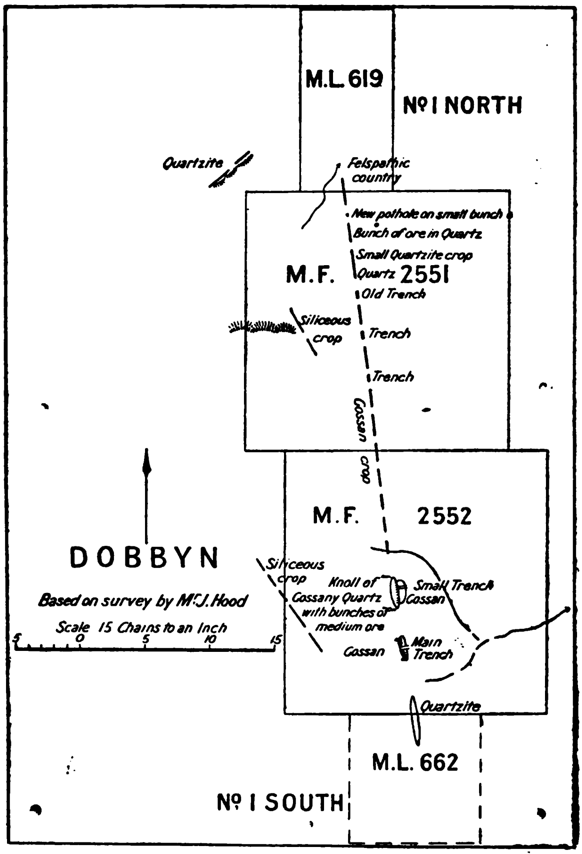
A big crop of quartzite striking north-west and south-east is to be seen in the north-eastern corner of the lease.

DOBBYN GROUP.

The Dobbyn freeholds lie 3½ miles west-north-west from the Mount Crusader freeholds, and the group includes, besides the two old freeholds, several leases and claims in their vicinity. Of these the Circe (M.C. ?) and Dobbyn 2 North (M.L. 646) were untested when visited and are not described below.

The country rock in the immediate vicinity of the ore-bodies is quartzite and schist, but a considerable development of schistose porphyry was noticed in the northern part of M.F. 2551.

Insufficient work has been done on the ore-bodies for it to be definitely decided as to what their nature is.



LITERATURE.

(2) Mr. Jack's visit was a hurried one, but he was able to note that "the lode is about 15 ft. wide and shows a promising gossan of green carbonate of copper mixed up with quartz."

(7) Mr. Rutherford's account of the Dobbyn is as follows:—

> The surface shows small "blows" of iron-stained quartz and quartzite, some of which are copper-stained. An irregular hole 20′ across and 10′ deep shows siliceous schist stained with carbonate. Mr. Henry informs me that he sent away 10 tons of rich ore picked up as loose boulders from the surface. I could see no indications of ore on this property, and consider it of little value.

Dobbyn (M.F. 2551).

LOCATION, ETC.

This is the northern of the two leases. It lies a mile west of Copper-mine Creek, at a point 10 miles above the Leichhardt River.

The block is 20 ch. square and contains 40 ac.

The work done consists of several old trenches, located at intervals of a few chains along the outcrop. Near the northern boundary miners, in ignorance of the ground being freehold, lately sunk a hole 8 ft. (*a*).

ORE-BODIES.

The new hole (*a*) on the northern boundary has been sunk on iron-stained and gossany quartz. About 6 tons of very siliceous malachite-bearing limonite is still at grass. This may carry 15% copper.

Southwards there is no crop to speak of, the ore presumably occurring as bunches in a crush zone whose general trend is indicated by the fragments of gossan and quartz on the surface. Little can now be seen in the shallow trenches opened many years ago to prove the lode.

Dobbyn (M.F. 2552).

LOCATION, ETC.

This adjoins M.F. 2552 on the south.

Its area is 40 acres.

The main cut, only 5 ch. from the southern boundary, is 20 ft. long and up to 8 ft. deep. A smaller trench lies 3 ch. to the north.

ORE-BODIES.

The main trench was opened in a gossany crop, and exposes the following section:

On the west is schist country;
Adjoining it is 5 ft. gossan;
Then 5 ft. ferruginous country,* slightly stained with copper;
Then 5 ft. very gossany country;
Then 2 ft. 6 in. iron-stained country;
Then 2 ft. 6 in. ferruginous and copper-stained country;
And on the east is barren schist.

There are about 20 tons of siliceous gossany ore at grass containing perhaps a little over 5% copper chiefly as malachite.

The little knoll to the north of the main cut is formed of gossany quartz with bunches of fair quality ore.

---

* On the opposite (the southern) side of the cut this zone is 4 ft. wide and consists of limonite, quartz, etc., with scattered patches of glance-limonite ore.

Dobbyn No. 1 South (M.L. 662).

Mgr., Sweeney.

LOCATION, ETC.

This adjoins M.F. 2552 on the south.

Its area is 10 acres.

A few potholes have been opened.

ORE-BODIES.

The ore-bodies are bunches, up to 15 in. wide, in schist, dipping very steeply to the east. These are located on a line, which, if continued, would run about a chain west of the Dobbyn main line of workings and crops.

Much of the ore is high grade glance, some of it mixed with malachite, and generally free from quartz. From one pothole 1 ton of pure glance was taken, and from a cut 3 tons of glance-malachite ore, probably averaging 30% copper, was secured.

Some dense, high grade, glance ore has been found here—free from other minerals than limonite and malachite, the former as minute specks evenly distributed through the mass, the latter as very thin veinlets. In addition a few grains of chalcopyrite, yet unoxidised, can be seen. Another quality of ore is the cavernous amorphous malachite, in the less open portions of which some glance occurs, indicating that the malachite has been produced from its oxidation.

Dobbyn No. 1 North (M.L. 679).

LOCATION, ETC.

This adjoins M.F. 2551 on the north.

Its area is 10 acres.

The one pothole, 5 ft. deep, is 2 ch. from the southern boundary.

ORE-BODY.

The pothole has been opened in the ferruginous quartz, representing the continuation of the Dobbyn crop, which is traceable for ½ ch. to the north. It exposes 3 ft. width of quartz, with malachite pinching to 18 in. at the bottom, owing to the eastern wall dipping westwards, while the western wall is nearly vertical. The ore is very siliceous, but also contains much iron, and rich bunches of ore will probably be found if sinking and driving are carried out.

The immediate country rock is schist, but schistose porphyry forms considerable crops in the vicinity.

Bauhinia (M.C. 347).

LOCATION, ETC.

The Bauhinia lies about ½ mile north of the No. 1 Dobbyn.

Two men's ground, 350 ft. × 400 ft., is here included.

One hole, 3 ft. deep, has been opened.

ORE-BODY.

The crop is quartz, striking nearly north-east. From the hole, which was full of water at time of visit, 7 bags (5 cwt.) of ore have been taken. This consists of limonite with disseminations and veins of malachite, a fair amount of granular quartz, some glance, and traces of the original chalcopyrite. It may be expected to yield 25% copper.

The only rock crops in the vicinity are of porphyry.

Widow (M.C.).

LOCATION, ETC.

The Widow is on the western bank of Soda Creek, 2 miles east of the Dobbyn freeholds.

It is one man's ground—350 ft. × 200 ft.

There is one hole, 5 ft. deep.

. ORE-BODY.

This appears to be a bunch of ore, not more than 10 ft. in length (east and west) and 18 in. wide, for though iron-stained quartz is to be seen on the surface, both east and west of the hole, the fragments have been shed from separate bodies.

The copper ore of which about 20 bags ($\frac{3}{4}$ ton) have been separated consists of crystalline cuprite, surrounded by malachite-bearing kaolin.

The country rock, felspar porphyry, is not sharply defined from the ore-body, and is kaolinised to the north-east of the hole.

Dobbyn Lily (M.C.).

LOCATION, ETC.

The Dobbyn Lily is $\frac{1}{4}$ mile north-east of the north-eastern corner peg of M.F. 2551.

It includes 2 men's ground, which has not been applied for.

One 6 ft. hole has been sunk.

ORE-BODIES.

Lumps of glance-malachite ore are found in lime-veined schist.

Elsie (M.C.).

Mgr., Madden.

LOCATION, ETC.

The Elsie is about 2 miles west of the Crusader freeholds.

It includes 3 men's ground—350 ft. × 600 ft., not applied for.

The two potholes, 4 ft. and 3 ft. deep, lie $2\frac{1}{2}$ ch. apart.

ORE-BODIES.

In the northern hole bunches of ore occur over a width of 3 ft., but, as it had lately been flooded, the exposure was not very distinct. About 5 tons of ore have been stacked. This consists of dense limonite, with disseminated radiating malachite and granules of quartz, and probably carries 10% copper, with 20% silica. This body is well worth sinking on.

For ½ ch. to the south 30° east of this hole the gossan has been silicified, but beyond that to the southern hole it carries little silica. The lode in the southern hole descends vertically and is only 12 in. wide. At the surface it is cellular, but beneath is more dense, and carries one-third malachite and chrysocolla, with say 20% silica. This also is worth sinking on, though the crop can be followed for only 6 ft. further southwards.

Nil Desperandum (M.C. 343).

Mgr., Wilmot.

LOCATION, ETC.

The Nil Desperandum is 1½ mile west of Coppermine Creek and 1 mile north of the Dobbyn freehold.

Its area is 400 ft. x 350 ft.—two men's ground, previously held as P.A. 289.

Four potholes have been sunk along and adjacent to the line.

OUTPUT.

2 tons shipped, 23½% copper (Alchin).

ORE-BODY.

A north-and-south crop of gossany quartz, with bunches of carbonate and oxide of copper, occurs in schists, dipping steeply to the east. The total length of crop is 3 chains, and holes have been sunk only where copper showed on the surface, leaving the most promising—the northern part—of the crop untouched.

Wilmot's (M.C.).

LOCATION, ETC.

Wilmot's is ¼ mile south of the Glenferrie.

One shallow trench has been opened.

ORE-BODY.

The ore is quartz, with limonite on joints, and carries chalcopyrite partly oxidised to limonite and glance. Of the copper ore (30% copper) about 1 cwt. has been stacked.

Glenferrie (P.A. 300)

Mgr., Wilmot.

LOCATION, ETC.

The Glenferrie is near Old Man Creek, 3 miles south of the Boundary.

Its area is 10 acres.

Two potholes have been opened, 1½ ch. apart.

ORE-BODY.

The work done does not allow of the size of the ore-body being determined for certain, but it is probably between 2 and 3 ft. wide. The northern portion of the crop consists of quartz, but at the workings it is chiefly calcite.

At the northern pothole there are a few hundredweights of dense earthy malachite and limonite, and fibrous radiating malachite ore (mammillary and stalactitic in cavities), containing some quartz, but capable of being hand-picked up to 40%. Further work should be done here.

At the southern pothole the ore consists chiefly of ferro-calcite with chalcopyrite and interstitial limonite and glance. It would be difficult to concentrate this ore by hand above 10 or 15% copper.

The country rock just to the east of the lode, which strikes north-north-west, is the porphyry, but diorite occurs on the road a few chains to the west.

Flaneur (M.L. 655).

Mgr., Alchin.

LOCATION, ETC.

The Flaneur lies 3 miles south-south-west of the Boundary claim and a mile west of the Dobbyn freehold.

The lease, which is 10 acres in area, includes the old Fop and Cad claims.

DEVELOPMENT.

The main shaft in the north-western portion of the lease is 30 ft. deep. It is proposed to open a drive to the south-east, the ore being much richer there than towards the north-west. Some 40 ft. to the north-west is a pothole 10 ft. deep and 4 ch. to the south-east is a cutting (the Cad) 3 ft. deep. A chain to the north-east of the main shaft there is a shallow trench on No. 2 lode, which has also been exposed to a depth of 4 ft., 2½ chains to the north-west.

Very little can be seen in any of the cuttings, and most of the ore at grass has come from the main shaft.

OUTPUT.

8½ tons bagged at grass, high grade.

ORE-BODIES.

Two distinct lines of crop, a chain apart, have been found on this property. There is no special sign of permanence in these lodes, except the fact that they crop for several chains on the surface.

In the shaft, on the south-western crop, the footwall country is a basic crystalline rock; the wall itself is ill-defined, but a smooth face has been found about 2 ft. in from the formation, which dips 5 in 1 to the north-east, varies from 9 in. to 2 ft. in thickness, and consists of crushed country replaced, in some parts, by quartz and, in others, by copper ores. The ore thus far has been richer in the south-eastern end, the dense limonite, beneath the surface quartz, having minutely interlacing veins of glance, with some specks of malachite, while tile-ore and crystalline malachite are appearing towards the bottom. Considerable boulders of a dense glance—presumably replaced limonite—are also found in the formation, stained on cracks by malachite.

A trench 10 ft. north-west of the main shaft has been opened on the quartz crop, and is reported to have touched ore, but has now fallen in.

The Cad cutting, opened in gossany quartz, proved fairly rich carbonate ore beneath.

The trench on the No. 2 lode tapped some medium ore, warranting further work on it.

On the south-western boundary there is a long crop of somewhat gossany quartzite, which might be tested in the more contracted parts by shallow holes.

BULL CREEK GROUP.

The group is named on the map after the Boundary. Bull Creek is a small affluent of Coppermine Creek, with a general course from west to east.

Porphyry outcrops are here as at the Dobbyn, very noticeable, especially towards the head of the creek.

The Boundary South (M.L. ——) is left out, as the holders failed to locate ore.

Boundary (M.L. 582).

Mgr., Lloyd.

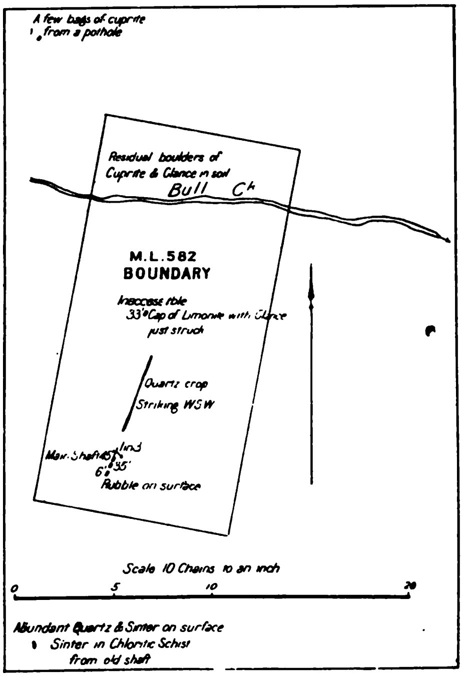
LOCATION, ETC.

The Boundary is located on the western boundary of the Coolullah run, in the north-western corner of Coolullah Block No. 2 West, about 4 miles north of the Dobbyn freehold. Bull Creek, a tributary of the Coppermine, runs through the northern part of the lease.

The area of the lease is 20 acres.

Development.

The main workings are at the southern end of the lease. The working shaft is 45 ft. deep, and an air shaft (inaccessible), 12 ft. to the south, is 35 ft. deep. At the bottom of the main shaft, drives have been opened, north for 12 ft. and south for 10 ft. No stoping has been done, but the shaft is 10 ft. long and 5 ft. wide.


A few bags of cuprite from a pothole
Residual boulders of Cuprite & Glance in soil
Bull Ck
M.L. 582
BOUNDARY
Inaccessible 33' Cap of Limonite with Glance just struck
Quartz crop Striking WSW
Main Shaft 45'
35'
6'
Rubble on surface
Scale 10 Chains to an inch
0
5
10
20
Abundant Quartz & Sinter on surface
Sinter in Chloritic Schist from old shaft

A pothole has been sunk 6 ft., at 20 ft. south of the air shaft.

Near the centre of the lease, a shaft has been sunk 33 ft. (inaccessible), and temporarily abandoned because of a sudden influx of water.

North of Bull Creek much "coyoting"—burrowing and shallow trenching in the soil—has been carried out, but in order to locate the lode or lodes it will be necessary to put a deep trench right across the copper-bearing ground.

Output.

65 tons* yielded from 20½% to 49½%

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[*] The value per ton at the mine being £15, when copper stood at £92 per ton.

ORE-BODIES.

The country rock is white, speckled, chloritic schist (possibly a crushed diorite), with segregated lenses of quartz, having a north-north-easterly trend. The cupriferous portion of the main ore-body makes little show on the surface, but the more siliceous parts are well marked.

In sinking the southern shafts boulders of rich ore were found to water level at 40 ft. On the 45-ft. level of the main shaft the copper ore is seen to occur in bunches in the lode, which itself is very irregular in width, the bulges being from 1 to 2 ft. thick. The copper ore at water level (40 ft.) is chiefly glance and with some chalcopyrite but small amounts of cuprite are found together with native copper. The gangue minerals are quartz (gossany in the northern level) and limonite (much of it siliceous). Some stains of malachite were noted and also a little chrysocolla.

The central shaft is a chain to the west of the line of strike of the main lode. Stains of carbonate and bunches of ore, with much calcareous sinter, were found in sinking and the cap of a lode, very jaspery in appearance but containing some glance, was struck at the bottom of the shaft. This, to judge by the ore at the brace, is worthy of further trial. The country rock here has suffered considerable alteration, being both softened and replaced to a large extent by earthy oxide of iron.

In the northern part of the lease scattered boulders of limonite, with glance and bunches of cuprite, coated with a thin film of chrysocolla, occur in the soil, with an abundance of sinter leached from the decomposed basic country rock. Solid rock has not yet been reached, and the lode has therefore not, so far, been located.

There would appear to be several overlapping lodes on this lease, though the work done does not allow of any very definite conclusions being drawn. The main lode strikes north-north-east, but the three groups of workings lie on a north and south line, and there is no sign of cross faulting.

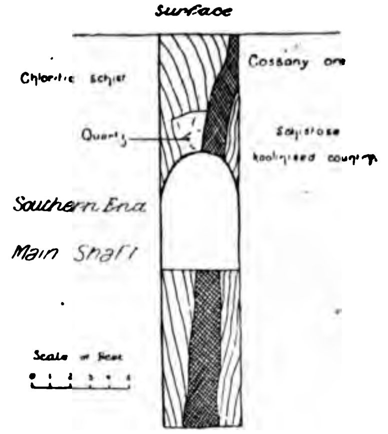
Decima (M.C. 304).

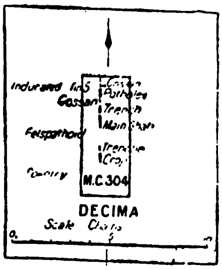
LOCATION, ETC.

The Decima lies on the reddish soil plain ½ mile south (slightly west) of the Boundary.

The vegetation consists almost entirely of stunted mountain (or desert) gum and spinifex.

The area, according to the Warden's register, is 400 ft. by 350 ft., but only half that area appears to have been pegged out. Unfortunately the claim, being under exemption, was deserted at the time of my inspection.





DEVELOPMENT.

The workings comprise two potholes, (*a*) 2 ft. 6 in. and (*b*) 5 ft. deep, at 14 and 16 yds. from the northern boundary; a trench (*c*), 18 ft. long and up to 7 ft. deep, 15 yds. south of the last; an opencut (*d*), 23 ft. long, 2 ft. deep at the northern end, 5 ft. in the middle, and 10 ft. at the south; the main shaft (*e*) adjacent to the last, 20 ft. (?) deep, has a drive, 10 ft. in length, from the southern end, at 12 ft. below the surface; a trench (*f*), 16 yds. south of the shaft, 4 ft. deep; and a trench (*g*), 30 yds. south of the shaft, 20 ft. long and 6 ft. deep.

The main shaft should now be continued to water-level in search of rich secondary ores, which are to be expected beneath all the gossan crops.

OUTPUT.

		5 tons shipped
1906	...	9 ,, bagged.

ORE-BODIES.

The Decima ore-body appears to be on a fracture plane of some extent and though this cannot be designated a true fissure, there is hope of some permanence. The only rock cropping at the surface besides the gossan is a porphyry, occurring as weather-rounded boulders, chiefly to the west of the lode, but the country rock adjacent to the lode is schist.

The Decima outcrop, which can be followed through the greater part of the claim, lies on the eastern side of, and partly within, an irregular belt of porphyry, which passes 10 ch. to the west of the

Boundary workings. Its strike is due north and south, and it is nearly vertical. Between the main and northern workings it is especially noticeable, consisting of up to 2 ft. 6 in. of gossan.

In the northern pothole (*a*) the footwall, which is well defined, dips 5 in 1 to the east. The lode is pinching slightly (from 2 ft. to 18 in.), but should be sunk on. About ½ ton of siliceous carbonate "seconds," of 10% tenour lies at grass.

The exposure in the trench (*b*) is similar, except that much decomposed country is included in the ore at the north end and that stains of carbonate are visible on the footwall. Only 1 ton of siliceous carbonate "seconds" is at grass.

The footwall country, in the main opencut (*c*) and in the shaft (*d*), is seen to be schistose but kaolinised, the hanging-wall country in the shaft being chloritic schist, broken by spurs of quartz. The lode, consisting of cupriferous gossany ore, increases from 18 in. near the surface to 2 ft. in width towards the shaft bottom. It occurs on a well-marked break, the footwall country further being kaolinised to a greater extent than the hanging-wall, which, however, is rich in quartz veins. The exposures in the shaft and drive are indicative of permanence, and the cupriferous gossan of rich secondary ores, beneath whence sinking should be continued. Of the ore raised 280 bags (12 tons) lie stacked at the shaft, the seconds—siliceous carbonate bearing gossan, containing 15% copper—amounting to 3 tons.

The trench (*f*) shows only 12 in. of gossan, the footwall country here being indurated adjacent to the lode.

Water in the trench (*g*) prevents a complete examination, but 6 in. to 18 in. of gossan is visible in the ends—the crop extending for 20 ft. south of the trench. Only "seconds"—cellular siliceous gossan, with thin veins of chrysocolla and malachite (3% copper)—amounting to ½ ton, remain at grass.

Iguana (M.C. 268).

Mgr., Huddlestone.

LOCATION, ETC.

The Iguana lies ½ mile north of the Boundary.

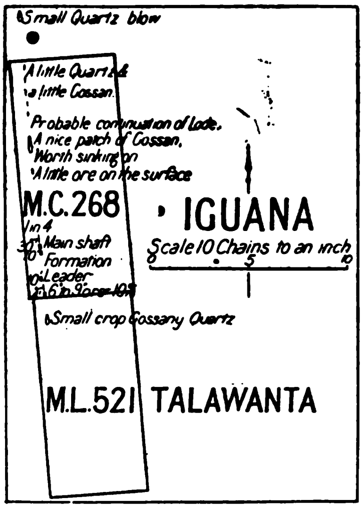
It is a mineral claim 800 ft. by 350 ft.—four men's ground.

OUTPUT.

Only 2 or 3 tons of ore have been shipped—yielding 37% copper, but 2 tons of ore lie bagged at the shaft ready for shipment. There are a few hundredweights of rich glance "firsts"—probably 40% ore—at the brace, and a few hundredweights of quartz-bearing limonite with radiating malachite, expected to carry 10 to 15% copper.

DEVELOPMENT.

On the southern boundary is a pothole (*a*) 4 ft. deep; a chain to the north is a hole (*b*), 10 ft. deep; a chain and a half further north is another (*c*) of the same depth. The main shaft (*d*), 20 ft. north of the last, is 30 ft. deep. Two men were at work here at the time of my visit.



ORE-BODIES.

The Iguana lode strikes north 5° west (dipping 4 in 1 westwards) and, if it continued southwards, would intersect Lloyd's main workings. The line of crop comprises small quartz blows, patches of gossan, and ore scattered over the surface of the ground; and it can be traced without difficulty some chains beyond the boundaries of the claim.

In the main shaft the ore to a depth of 10 ft. consisted of quartz-bearing limonite containing malachite, but the ore now being raised from 30 ft. depth contains glance as well as malachite. The copper ore occurs in ill-defined bunches, up to 2 ft. in width, in a formation of internally slickensided and kaolinised schist—4 ft. across in places. The hanging-wall, which cannot now be seen in the shaft, is reported to be very smooth, and this, with the slickensides in the schist, indicates the formation to be a shear zone, in which other bunches of ore are to be expected in depth.

In the pothole (*c*) the formation can be distinguished but no ore.

In the southernmost pothole (*a*) there is 6 in. to 9 in. of siliceous ore, dipping steeply west in schist country. The ore is stained by malachite and may be expected to assay 10% copper.

The pothole (*b*) is on a leader, at least 10 ft. west of the main lode. No copper ore has been found in it.

Cathedral (M.L. 573).

LOCATION, ETC.

The Cathedral lies 1 mile west of the Boundary.

Its area is 20 ac. and the ground was formerly held as the Peacock claim.

It was idle at the time of my visits to the locality, no work having been done on it since its conversion from a claim.

OUTPUT.

1½ tons (red oxide) yielded 43% and 35%

,,

ST. PAUL'S GROUP.

St. Paul's Creek enters the Leichhardt River about half way between Coolullah and Kamileroi homesteads, draining a large area of country to the south-west.

Little work has been done on any of the crops, and no body of any importance has yet been discovered.

The Pelican was not visited.

Rosette (M.L. 638).

Mgr., Steel.

LOCATION, ETC.

The Rosette lies ¾ mile east of St. Paul's Creek and 4 miles north-west of the Boundary.

This is a lease of 10 acres.

The main shaft, 20 ft. deep, is in the western corner of the lease; two potholes, 6 ft. and 5 ft. deep and 8 ft. apart, lie a chain to the south-east and a small trench has been opened in the northern corner.

OUTPUT.

	6	tons	shipped, Nov. '06,	expected 30%	(Mgr.)
	½	,,	firsts	yielded 40⅜%	(M.O'S)
		,	seconds	,, 33⅝%	,,
Total	7	,,	shipped		

ORE-BODIES.

The little work done here has not shown anything of promise—the ore occurring in bunches in small formations of no extent so far proved.

The main shaft has been sunk in copper-stained, kaolinised, chloritic schist, on a 12 in. formation, striking north 15° east, in which bunches of ore are found. The ore raised—malachite and glance—amounting to 6 tons has been shipped and is expected to yield 30%.

The western pothole exposed a formation 9 in. to 12 in. wide, while the eastern pothole shows a separate formation, 6 in wide, from which 1½ ton of malachite and tile-ore, assaying 42%, has been bagged.

At the northern trench there is a lenticular bunch of iron-stained quartz, in schist country, probably less than 20 ft. long but up to 10 ft. wide. The quartz is glassy and shattered, the cracks being lined with hydrated iron oxide, in which specks of gold have been detected by the manager.

The copper ores (carbonate and oxide) occur in a formation in juxtaposition to this. About 1¼ ton of rich ore has been taken from the trench.

Lady Emma (M.C. 356).

Location, Etc.

The Lady Emma is located 2 miles up St. Paul's Creek from Hill's Camp and the Chance.

There is one shaft 12 ft. deep.

Output.

5 tons shipped.

Ore-body.

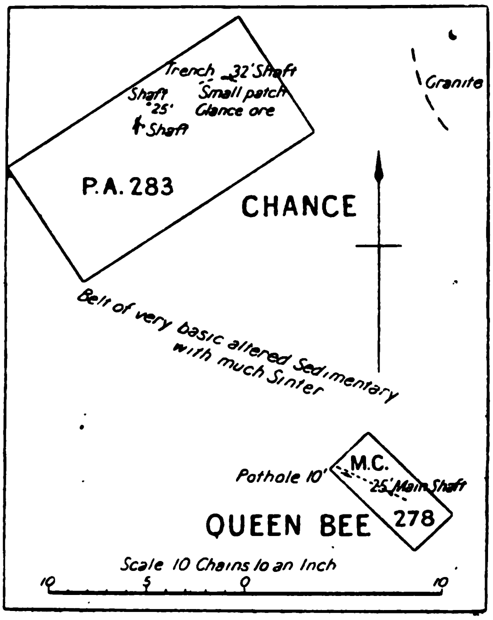
It is reported that the ore-body, which is of fair grade, is 2 ft. wide.

Chance (P.A. 283).

Location, Etc.

The Chance lies 4¾ miles west of the Boundary and 1 mile beyond St. Paul's Creek.

Its extent is 10 ac.



DEVELOPMENT.

The main workings are in the northern corner of the area. The main shaft is 32 ft. deep and is now being sunk a further 10 ft. in search of bunches of ore. Separated from the main shaft by only 2 ft. is a pothole, 10 ft. deep on the east; and 10 ft. to the west there is a trench 10 ft. long, with a hole 10 ft. deep at the western end. A hole has been sunk 15 ft. 4 ch. to the west-south-west from the last, and a chain beyond to the south-west of there is a shaft 15 ft. deep.

OUTPUT.

2 tons shipped by previous holders, 43% and 35% copper (Seaton)
6 ,, bagged at grass, expect 37% copper
6 ,, ,, ,, ,, 30% ,,
3 ,, ,, ,, ,, 40%

ORE-BODIES.

The amount of work done on the Chance does not warrant certain expression as to whether there is one or more lodes, though the former has been assumed to be the case. The country in the area is a slaty rock, which, in the northern workings, is seen to be schistose. The occurrence of intrusive granite, only 10 ch. distant from the workings, is suggestive as to origin, but there are no pneumatolytic minerals accompanying the ores. Still the heat evolved by the granite must have aided solutions in dissolving the metals prior to precipitation in concentrated form.

The rich ore has evidently been originally chalcopyrite, but partial oxidation has taken place, through the whole mass, the iron producing limonite and the copper glance. These minerals now appear as a liver-coloured base, in which are scattered specks of yellow chalcopyrite.

At the main shaft the strike is west-north-west. It was opened on a 2 ft. formation, which widened to 2 ft. 6 in. at 20 ft. below the surface, but has pinched to 12 in. at the bottom. The formation, which is ill-defined, with very irregular walls, in parts consists entirely of crushed country but in others carries bunches of rich ore, some gossan, and quartz. Their scattered occurrence, however, renders exploitation somewhat expensive—only 10 tons of (37% to 42%) ore having been raised, of which 6 tons bagged are still on the ground. The ore at the brace, amounting to 5 cwt., consists of enriched chalcopyrite and glance and probably contains 60% copper.

The country rock at the main workings is schist the apparent strike of which is west-north-west, but granite occurs within 10 ch. to the east.

Only a 6 in. formation can be seen in the trench west of the shaft, but glance ore lies on the surface a chain further west.

The 25 ft. shaft has been sunk, in bleached country, on a very ferruginous formation, 2 ft. wide, consisting in great part of limonite, and containing tile-ore and chalcopyrite in limonite, but remarkably free from quartz. The ore at grass amounts to 6 tons, expected to yield 30% copper. Sinking should be continued here as the most promising place on the area.

The south-western shaft is at the contact of quartz, which crops on the surface for over a chain, and gossan, latter about 2 ft. thick and dipping steeply south-east. The country is slaty and the walls are not defined. Three tons of ore have been bagged from this shaft.

Queen Bee (M.C. 278).

Location, Etc.

The Queen Bee lies 500 yds. south-south-east of the Chance, on a flat covered with mountain gum and spinifex.

This is an ordinary claim of two men's ground—400 ft. × 350 ft.

The main shaft which is 8 ft. long and 6 ft. wide is 25 ft. deep; and, 2½ ch. to the west-north-west, there is a hole 10 ft. deep.

Output.

1½ ton shipped, carrying 35 to 43% ore (Seaton)

3 tons just shipped } expected to yield 20% copper
1 ton at grass }

Ore-bodies.

Beyond that the claim is in metamorphosed sediments in the vicinity of granite and that the ores occur in an irregular formation little can be said.

The ore-bodies in the main shaft occur in an irregular formation, perhaps 10 ft. wide, making no show on the surface. Attached to the hanging-wall, which strikes north-west and dip almost vertically to the south-west, is much sintery kaolin, and "floors" (flat sheets) of sinter also occur in various parts of the formation. The ore consists of limonite and glance.

An indistinct jointing, or bedding, crosses the shaft almost at right angles to the formation, but the exposure is very indefinite.

The pothole to the west-north-west is also on a formation worth prospecting.

A ton of ore lying at grass consists of limonite stained by carbonate and containing a few specks of the original chalcopyrite, with copper amounting to perhaps 5%.

In addition to this 17 bags of 45% glance ore are said to have been taken from here.

Copper is distributed throughout the mullock tip, which amounts to at least 100 tons and probably contains 3% copper.

DONALDSON.

The mines north-west of the Donaldson telegraph station were the latest discoveries seen by me. They are situated on the eastern side of the Dromedary Range, which extends northwards for nearly 30 miles from Coolullah homestead.

The Black Nobby (M.L. 684) was not visited, and no particulars regarding it are available, except that it lies 8 or 10 miles north of the Eclipse Group.

ECLIPSE GROUP.

The group is located 9 miles west of the Cloncurry-Normanton telegraph line and is 68 miles north-by-west from Cloncurry.

The surrounding country is low-lying, being part of a peneplain, approaching the base level of the neighbouring rolling downs. The surface features much resemble those of the Duck Creek and other wide-bottomed valleys in the Cloncurry district.

The leases had not been surveyed when they were visited at the end of 1906, and the men on the ground were unable to give me the boundaries of the leases, consequently the particulars given below are somewhat indefinitely stated.

Metamorphism has been intense in this district, but it has taken place without the excessive crushing and the production of cupriferous quartz-bearing zones so typical of the greater part of the mineral field. The country rocks noticed include quartzite, hornblende-schist, felsite, pegmatite, etc., and quartz lenses are not as frequent as in most other parts of the field.

Stunted bloodwood is the most abundant timber, being generally accompanied by spinifex.

Eclipse (M.L. 571.)

Mgr., Hillcoat.

LOCATION, ETC.

The Eclipse is situated 12 miles north-west of Donaldson telegraph station which is 58½ miles north-by-west of Cloncurry.

Its area is 10 ac.

DEVELOPMENT.

The workings, which are all in a state of collapse, begin 4 ch. north-west of the south-eastern corner of the lease, with 2 potholes, the eastern 5 ft. and the western 6 ft. deep, 1 ch. north of which is the main shaft, 15 ft. deep. A third pothole 5 ft. deep lies 20 ft. south-west of the main shaft. The northern shaft, about 15 ft. deep, is 3 ch. north-north-west of the main shaft. At 20 ft. south-east of this shaft there is a trench 8 ft. long, 6 ft. wide, and 4 ft. deep.

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LOCATION, ETC.

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This is an ordinary claim of two men's ground—400 ft. x 350 ft.

The main shaft which is 8 ft. long and 6 ft. wide is 25 ft. deep; and, 2½ ch. to the west-north-west, there is a hole 10 ft. deep.

OUTPUT.

1½ ton shipped, carrying 35 to 43% ore (Seaton)
3 tons just shipped } expected to yield 20% copper
1 ton at grass }

ORE-BODIES.

Beyond that the claim is in metamorphosed sediments in the vicinity of granite and that the ores occur in an irregular formation little can be said.

The ore-bodies in the main shaft occur in an irregular formation, perhaps 10 ft. wide, making no show on the surface. Attached to the hanging-wall, which strikes north-west and dip almost vertically to the south-west, is much sintery kaolin, and "floors" (flat sheets) of sinter also occur in various parts of the formation. The ore consists of limonite and glance.

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Stunted bloodwood is the most abundant timber, being generally accompanied by spinifex.

Eclipse (M.L. 571.)

Mgr., Hillcoat.

LOCATION, ETC.

The Eclipse is situated 12 miles north-west of Donaldson telegraph station which is 58½ miles north-by-west of Cloncurry.

Its area is 10 ac.

DEVELOPMENT.

The workings, which are all in a state of collapse, begin 4 ch. north-west of the south-eastern corner of the lease, with 2 potholes, the eastern 5 ft. and the western 6 ft. deep, 1 ch. north of which is the main shaft, 15 ft. deep. A third pothole 5 ft. deep lies 20 ft. south-west of the main shaft. The northern shaft, about 15 ft. deep, is 3 ch. north-north-west of the main shaft. At 20 ft. south-east of this shaft there is a trench 8 ft. long, 6 ft. wide, and 4 ft. deep.

OUTPUT.

1906	...	17 tons shipped
		20 ,, at grass, 30%

ORE-BODIES.

The country rocks here are highly metamorphosed, hornblende-schist being much in evidence in the southern part of the lease. Towards the north there is also a considerable development of granophyric and some pegmatitic structure, in the more siliceous and felspathic rocks. Almost all the openings on the lease appear to be on different ore-bodies.

The main shaft is on an irregular north and south striking bunch of high grade liver-coloured ore (an intimate mixture of chalcopyrite, tile-ore, limonite, and chalcocite with disseminations and veinlets of malachite). The body is 3 to 4 ft. wide at the surface but at 8 ft. below it is from 6 in. to 3 ft. wide. About 10 tons of 30% ore lie at grass. The country adjacent to the ore is a decomposed rock, probably slate.

At the 5 ft. hole to the south, which is on the same line, 5 tons of 30% ore have been paddocked, while at the adjacent hole there is the same quantity of 35% ore.

The hole to the south-west of the main shaft has produced 1 ton of 40% liver-coloured ore.

Gossan can be seen on the surface at the northern shaft but there is little sign of it continuing any distance, though rich ore is showing, over a width of 2 ft., along the whole length of the adjacent trench, and another 6 in. crop of fairly rich ore can be seen 2 ch. to the south. The country here is a highly altered felspathic rock. In all 10 tons have been shipped from the northern workings and there is 1 ton of 30% oxidised ore at grass.

Lady Catherine (M.L. 621).

Mgr., Hillcoat.

LOCATION, ETC.

The Lady Catherine adjoins the Eclipse on the south.

Its area is 10 ac.

ORE-BODIES.

No crops were seen in this lease but the soil is highly ferruginous and similar bodies of ore to those found in the Eclipse are to be looked for.

Lady Molly (M.L. 620).

Mgr., Hillcoat.

LOCATION, ETC.

The Lady Molly adjoins the Eclipse on the north.

Its area is 10 ac.

Only two or three shallow potholes have been opened on this lease about ½ mile north of those on the Eclipse.

ORE-BODIES.

The country rock here has the appearance of highly altered sedimentaries, in which segregation and crystallisation has taken place with the production of a pegmatitic structure in parts. Small ore-bodies, 18 in. wide, have been exposed on a north and south line in the eastern holes, but only a couple of hundredweights of payable ore have been saved.

A belt of quartzites, lying 1 ch. to the west, shows slight indications of copper contents, and a small hole, in sintery red soil at the northern end of the belt, has yielded a few pounds weight of copper ore.

Work is therefore not to be encouraged here.

Cosmo (M.L. 668).

Mgr., Hillcoat.

LOCATION, ETC.

The Cosmo adjoins the Lady Molly on the west.

Its area is 10 ac.

Wanderer (M.L. 622).

Mgr., Hillcoat.

LOCATION, ETC.

The Wanderer lies ¼ mile west of the Cosmo.

Its area is 15 ac.

One pothole 5 ft. deep has been opened.

OUTPUT.

3 tons of ore raised, carrying 30% copper.

ORE-BODY.

The ore obtained appears to have been in the form of a small bunch. Cellular gossan was found on the surface and underneath it fine-grained glance-malachite-tile-ore, rich in iron but free from quartz.

Hornblende schist and an altered porphyroidal rock occur in the vicinity. The sedimentaries are highly altered and pegmatitic segregations are very common, more especially on a line running north-east and south-west within a few feet of the pothole. Actinolite is here a very abundant secondary mineral.

Nothing to encourage further work was seen here.

GUNPOWDER CREEK.

Gunpowder Creek rises near Kennedy's Gap on the West Leichhardt telegraph line, and flows northwards to within a few miles of Mount Oxide, when it bends and runs east-north-east to the Leichhardt River. The country within its catchment is mostly mountainous, and uninviting for most purposes.

CALTON HILLS GROUP.

Only one lease had been taken up here at the end of 1906, to my knowledge.

Overlander (M.L. 661).

LOCATION, ETC.

The Overlander is 17 miles down Gunpowder Creek from Calton Hills homestead, which is 81 miles west-north-west of Cloncurry.

Its area is 10 ac. The lease was not inspected.

Rich specimens of radiating malachite in quartz were shown me by one of the owners, who reported the mineral to be plentiful.

BIG BEN GROUP.

This group is to the north and on the opposite side of Gunpowder Creek to the Overlander.

Besides that described below, there are the Big Ben No. 1 (M.L. 574) and Big Ben No. 2 (M.L. 575).

Big Ben (M.L. 380).

LOCATION, ETC.

Big Ben lies east of Gunpowder Creek, 21 miles north-north-west of Calton Hills, and 98 miles north-west of Cloncurry.

Its area is 5 ac.

OUTPUT.

About 10 tons of ore have been shipped.

EASTERN CREEK GROUP.

Eastern Creek is one of the eastern tributaries of Gunpowder Creek, entering it about 15 miles north of Calton Hills Station.

The Osprey (M.L. 726) which is located at the head of the creek is the only lease in the group.

MOUNT OXIDE.

Mount Oxide is located between Torpedo Creek (a branch of Gunpowder Creek) and Myally Creek (a tributary of the Leichhardt River). It is in the extreme north-west of the district considered in this report.

MOUNT OXIDE GROUP.

Mgr., Douglas Henry.

LOCATION, ETC.

Mount Oxide lies in about the centre of the triangle formed by joining Camooweal, Burketown, and Cloncurry. The nearest human habitation at the present time is Alsace, 25 miles down Gunpowder Creek; its distance, in an air line from Burketown, being 123 miles and from Cloncurry 109 miles.

The leases are strung along a precipitous ridge, near the head of a branch of Torpedo Creek, 6 miles above the junction of the latter with Gunpowder Creek, a stream of some importance, entering the Leichhardt River between Kamileroi and Lorraine head stations.

A track for vehicles has lately been made, *viâ* Myally Creek, from the mine to Lorraine, on the Cloncurry-Burketown road (60 miles), but horsemen generally prefer the short cut (50 miles) from Kamilaroi, *viâ* Alsace. A camel pad westwards has lately been opened down the Thornton River to the Camooweal-Burketown road (55 miles).

LITERATURE.

(4) The following are Mr. Cameron's statements:

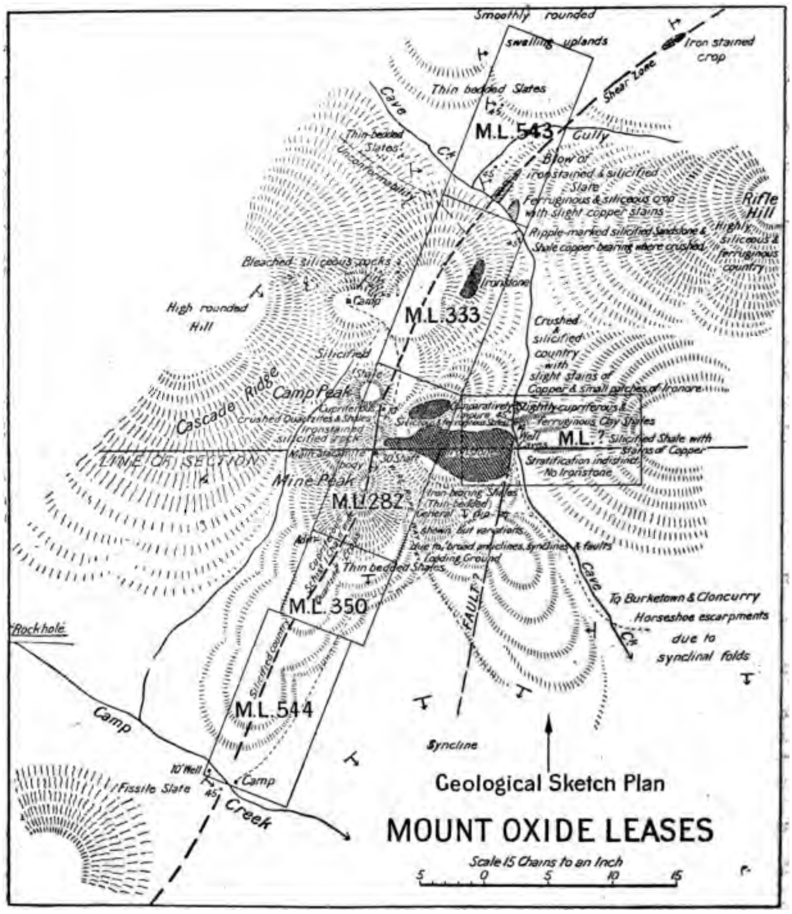
> The crest of the spur is formed by a band of bedded quartzites which outcrop along it, striking about south 30 degrees west, and dipping steeply to the east. Underlying this quartzite belt is a bed of clay shales. The lode consists apparently of the upper beds of these shales impregnated with fine quartz veins and copper ores. It shows as a very prominent outcrop along the crest of the hill for a distance of some 10 chains in length, and is in places 40 feet in breadth. An average sample across the southern end of the outcrop gave a return of 1·3 per cent. of copper, a trace of gold, and 9 dwt. 2 gr. of silver per ton. Another average sample taken from across the lode about 8 chains further north gave a return of 28 per cent. of copper, a trace of gold, and 1 oz. 10 dwt. 1 gr. of silver per ton. The lode here is about 10 feet in width, and is more ferruginous and quartzy in character, and continues so for about 2 chains further north. Beyond this it can be traced for a further distance of about 5 chains by detached outcrops of quartz and carbonate ore. This lode will be an expensive one to work from its inaccessibility, but otherwise it shows very good prospects. The initial prospecting could very easily be done by open cuts across the lode from the western side before any more elaborate work was taken in hand.

(7) Mr. Rutherford concludes:

> The outcrop is made up of a prominent ridge of bedded quartzite running in a north and south direction for a distance of 300 yds. Underlying the quartzite is in places a band of shale which is generally more stained with green carbonate than the quartzite itself. The "stained" formation varies in thickness from a few feet up to 40 ft. in places. At a place 130 yds. from the extreme northern end the formation is 15 ft. wide. Three feet of this carries some good copper ore for a distance of 17 yds. This is the only place where any body of ore can be seen. It is my opinion that a bulk assay right across the formation in any other part would not yield more than a trace of copper.

HISTORY.

Mr. Henry was taken by blacks to Mount Oxide about 25 years ago. He secured the ground in 1900, and placed it, on option, in the hands of the Burketown Railway Company, who abandoned it in 1903. Early in 1905, Mr. Henry again pegged out the ground and placed his son in charge. On my arrival at the mine, Mr. Douglas Henry had four men with him.



Geological Sketch Plan

MOUNT OXIDE LEASES

Smoothly rounded swelling uplands
Iron stained crop
Shear Zone
Thin bedded Slates
45
Cave Ck
M.L. 543
Gully
Thin-bedded Slates
Unconformability
Blow of ironstained & silicified Slate
Ferruginous & siliceous crop with slight copper stains
Rifle Hill
Highly siliceous & ferruginous country
Ripple-marked silicified Sandstone & Shale copper bearing where crushed
Bleached siliceous rocks
Camp
High rounded Hill
Ironstone
M.L. 333
Crushed & silicified country with slight stains of Copper & small patches of Ironore
Silicified Shale
Cascade Ridge
Camp Peak
Cupriferous
Crushed Quartzites & Shales
Ironstained silicified rock
Comparatively pure
Silicified ferruginous Slates
Slightly cupriferous & Ferruginous Clay Shales
Well
M.L. ?
Silicified Shale with Stains of Copper
Stratification indistinct No Ironstone
LINE OF SECTION
Main body
30 Shaft
Mine Peak
M.L. 282
Iron-bearing Shales Thin-bedded
General dip shown but variations due to broad anticlines, synclines & faults
Folding Ground
Adit
Schist
Thin bedded Shales
M.L. 350
FAULT ?
Cave Ck
To Burketown & Cloncurry
Horseshoe escarpments due to synclinal folds
Rockhole
Silicified country
M.L. 544
Syncline
Camp
10' Well
Fissile Slate
45
Camp
Creek
Scale 15 Chains to an Inch
5
0
5
10
15

AREA.

The leases are five in number: The Mount Oxide (M.L. 282), No. 1 North (M.L. 333), No. 2 North (M.L. 543), No. 1 South (M.L. 350), No. 2 South (M.L. 544), and No. 1 East (M.L. ?), and the area is 10 acres in all cases except that of No. 1 South, which is only 5 acres. They have not been surveyed, and the manager has no plan, that published herewith having been made by me on the ground with Mr. Douglas Henry's assistance in locating datum pegs, &c.

DEVELOPMENT.

The main workings are on M.L. 282: A 30-ft. shaft, and an opencut, 8 ft. deep, 8 ft. wide and 20 ft. long, just to the south-west of the shaft. Three chains to the north is an abandoned shaft, 10 ft. deep.

In the north-western corner of M.L. 350 an adit, now 7 ft. long, has been commenced nearly 100 ft. below the ridge top.

In the south-western corner of M.L. 544, a well has been sunk, to a depth of 70 ft. in purple and yellowish-green fissile slate. Very little water was obtained.

On M.L. (?) is a 14-ft. well, giving a fair supply of water for one man.

The workings being in the initial stage, the ore-raising appliance consisted simply of a windlass and a No. 4 wire rope-way to the loading ground, 8½ ch. distant.

OUTPUT.

1905	...	40	tons	ore,	containing	30%	copper	
1906	...	40	„	„	„	30%	„	
		30	„	„	„	40%	„	(estimated)
Total		110	„	„	„	33%	„	„

ORE DEVELOPED.

The main ore-body has not yet been sufficiently opened up for a reliable estimate of ore available to be made. At the time of my visit the main bunch of ore could be traced, on the surface, a distance of 2¼ chains, but had been properly exposed only in the opencut and shaft. It may, however, reasonably be assumed that ore will be found between the surface and lines joining the ends of the crop and the shaft bottom. The average width remaining 3 ft., over 700 tons, which ought to run between 20 and 30%, should be available.

No work has been done on the cupriferous schists, and therefore no opinion can be expressed as to their value.

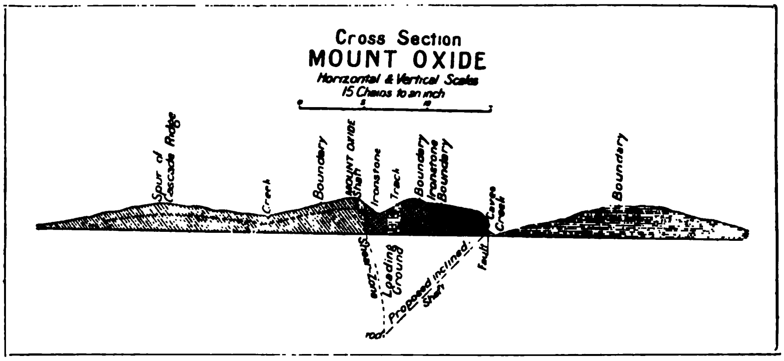
TREATMENT AND TRANSPORT.

The only treatment the ore receives at the mine is a rough sorting by hand, prior to bagging. When bagged it is carried 55 miles by camel to the Thornton Hotel, on the Burketown road, where it is transferred to horse teams, on their way to Burketown, and thence shipped to Southern smelters.

GEOLOGY AND MINERALOGY.

The Mount Oxide ore-bodies lie along a shear-zone, which is traceable for several miles, at least to Torpedo Creek on the south, but has not yet been proved cupriferous beyond Henry's leases.

The country rocks to the west are fissile slates, dipping at an angle of 45° to the south-east; to the north-east, the country is highly silicified and shows little trace of stratification (any observed having a southerly dip); but, to the south-east, occur apparently overlying, thin-bedded, calcareous slates, forming a broad geo-syncline, with north and south major axis.



Along the shear-zone, the slates have been rendered schistose, generally highly siliceous, and in places cupriferous. One bunch of high-grade oxychloride has been found and is being exploited in the main shaft (*see* Mount Oxide—M.L. 282).

Between the shear-zone of Mount Oxide on the west and a fault and crush zone in Cave Creek on the east, several bodies of ironstone occur. The largest crop (at the Caves) is 300 ft. wide tapering down to less than 100 ft. at the western extremity. The eastern end is rendered conspicuous by its towering 100 ft. above the creek.

Reference to the occurrence and composition of these iron ores will be found elsewhere.

There is a probability that all the above strata are of the same age, the shear-zone, crush-zone, and faults being due to the forces which produced the geo-syncline, and the induration being due to earth pressure and cementation by deposition of silica from circulating solutions.

The Mount Oxide ore-bodies are thus located on the fractured edge of a syncline, where ground waters have had full scope to circulate.

Mount Oxide (M.L. 282).

The main shaft* was begun in country rock (slate decomposed into ferruginous kaolin internally slickensided), 5 ft. east of a body of carbonate and oxychloride, which was cut at 20 ft. from the surface. The bottom of the shaft is wholly in ore, the footwall of the deposit not yet having been met, owing to a steepening of the dip as depth increases. The hanging-wall is very irregular and ill-defined. The ore from the shaft, consisting of carbonate, oxychloride, and oxide, contains as impurity only from 20 to 30% of clay, indicating replacement of decomposed country.

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* Reports came to hand towards the end of 1907 that the shaft had been sunk 74 ft. and crosscuts were then opened 25 ft. west and 17 ft. east, the former in 5% ore the latter in 42% ore. No confirmation has, however, yet been received of this.

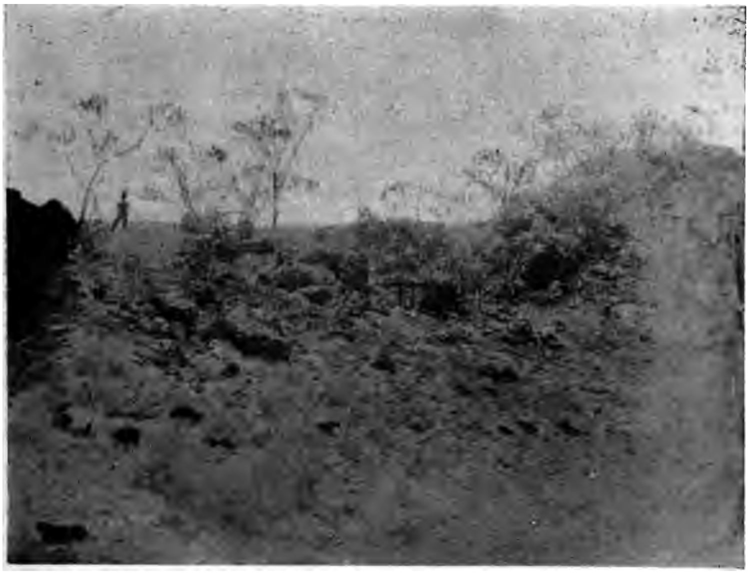


FIG. 25.—MAIN SHAFT, MOUNT OXIDE. [*L. C. B., photo.*

The same ore-body has been exposed by open-cutting, over a distance of 20 ft., to within 15 ft. of the shaft, the face there being 6 ft. in width, and in the centre of the cut it is 8 ft. wide. At the shaft the crop is only 5 ft. wide, and thence tapers out within 20 ft. to the north.

Between 25 or 30 tons of ore now lie stacked at the shaft, ready for bagging. My sample, taken from the surface of this heap, contains crystalline atacamite, both with and without interstitial earthy red oxide of iron; crystalline atacamite, between laminæ of kaolinised schist; and earthy malachite and red oxide (tile-ore), with crystalline atacamite drusy on the walls of cavities. The following is its analysis (Government Analyst):

Copper	= 38·6%	
Gold	= 19 gr.	per ton
Silver	= 1 oz. 18 dwt.	,,

The 15 tons of seconds, at grass, containing a large amount of atacamite (acicular and green), probably run 20% copper.

The body continues on the west of a silicified gossany crop for nearly a chain south of the opencut, the amount of copper rapidly decreasing. About 2 ch. south of the cut, is silicified slate highly stained—but only on the surface—by green carbonate. This forms the footwall country of a very ferruginous, sometimes gossany, body of silicified slate, which may be found to carry occasional bunches of copper ore in depth.

Some 20 ft. north of the main shaft there is a crop, 2 ch. in length, of iron-stained silicified rock, on the eastern side of a thin belt of copper-stained schistose slate, in which quartz lenses have segregated. North again of these crops silicified crushed schist and quartzite, 30 ft. wide, rise above the surface for nearly a chain.

In appearance the crop much resembles the Chinaman, on Duck Creek, except in that, though so siliceous, it contains few bunches of pure quartz. This crushed country contains copper, but seldom to the amount of 10%, though the surface is generally green painted.

The body has been left exposed, for a height of 30 ft. on the east, by the denudation of the adjacent country and it could therefore be easily tested by an adit, but instead a shaft has been begun a few feet north-east of the cliff to catch the body on the underlie.

North of the shaft, the cupriferous portion is only 3 or 4 ft. thick, and it thins out altogether within a chain.

Towards the southern boundary of the lease the footwall schists are strongly stained by blue and green carbonates, over a width of a chain, the slates, both east and west, being both ferruginous and siliceous.

Mount Oxide No. 1 East (M.L. ?)

In the northern part of the lease, on the eastern side of the creek and about 5 ch. north-east of the Caves, is an area of broken, silicified, cherty country (altered shales), stained and veined with malachite over a width of 12 ft. and a length of 30 ft. The copper contents are certainly less than 5%, and it was not thought worthy of sampling.

Another crop of silicified shale, with slight stains of copper carbonate, lies east of the Caves.

A great part of the ironstone crop, described elsewhere, is included within the lease, but no work has yet been done on it. A rough computation of the amount of iron ore above the level of the creek places it at over a million tons.

Mount Oxide No. 1 North (M.L. 333).

No work whatever has yet been done on this lease, though the silicified crush-zone can be traced through it from south to north.

A crop of ironstone a few chains in length lies near the centre of the lease.

Another crush-zone, an extension of the Cave Creek fault, traverses the north-eastern corner of the lease, and here stains and fillings of malachite and tile-ore are found in crushed, ripple-marked, indurated sandstone, the grade of which is very low.

Mount Oxide No. 2 North (M.L. 543).

The crush-zones continue through the south-eastern corner of this lease, and slight stains of copper ore are visible.

Mount Oxide No. 1 South (M.L. 350).

The quartzites and schists of the main crush-zone crop through this lease, the latter, however, pinching out towards the south. The schist is rather gossany and sometimes contains stains of malachite. It is covered to some extent by talus, and no work has been done on it, but an adit has been begun on the western side of the ridge, ½ ch. from the northern boundary, and this is intended to intersect the schist, 50 ft. below the crop.

Mount Oxide No. 2 South (M.L. 544).

A belt of silicified country traverses this lease from north to south, and a shaft has been sunk in the footwall country in the south-western corner, but no copper has been found.

MOUNT GORDON GROUP.

Mount Gordon is located adjacent to Oxide Creek, 2 miles north-north-east of Mount Oxide, and overlooks the Burketown road and Alsace bridle-track.

Four leases are in force here: Mount Gordon (M.L. 597), Mount Gordon No. 1 North (M.L. 598), Mount Gordon No. 1 South (M.L. 599), and Mount Gordon No. 2 South (M.L. 600)—each of 10 acres.

No work has been done on any of them except M.L. 597, and the ground was quite deserted during my stay in the district.

Mount Gordon (M.L. 597).

LOCATION.

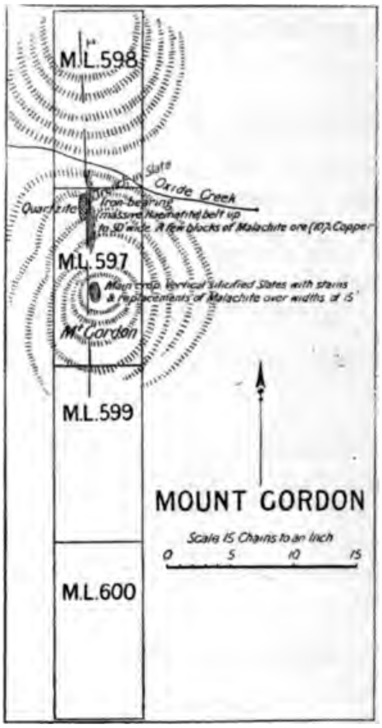
This lease is situated on the southern side of Oxide Creek.

DEVELOPMENT.

A trench, 6 ft. long, 3 ft. wide, and 1 ft. deep, has been opened in the northern portion of the lease but failed to locate ore. No work has been done on the main crop, which should first be examined by trenching; and then if indications warrant it an adit might be opened, either from the north or south, along the cupriferous zone. Alternatively a shaft might be sunk on the crop itself and crosscuts opened at various depths.

ORE-BODIES.

No lode has been found here, the copper ore occurring in patches, in a north and south belt of siliceous slates, together with much hæmatite. The copper ore in the main crop on the hill-top, near the centre of the lease, is chiefly malachite, which occurs in veinlets both on the bedding planes and in joints, and also disseminated in the solid country rock, which has a greenish tinge when broken. Carbonates are especially well developed at one spot, where the quartzite has been crushed in a similar manner to parts of the Chinaman crop at Duck Creek.


M.L.598
Slate
Oxide Creek
Quartzite
Iron-bearing (massive Haematite) belt up to 50' wide. A few blocks of Malachite ore (10% Copper
M.L.597
Main crop. Vertical Silicified Slates with stains & replacements of Malachite over widths of 15'
Mt Gordon
M.L.599
M.L.600
MOUNT GORDON
Scale 15 Chains to an Inch
0
5
10
15

Much of the stone has a superficial staining of carbonate, which has been leached out from the interior, and gives an altogether erroneous idea of the value of the stone, on a cursory examination.

The copper ores occur in the slates over widths of up to 15 ft., but the richest patches seldom carry as much as 10% of copper.

APPENDIX.

BURKE RIVER (Continued).

MOUNT BIRNIE GROUP (Continued).

Mount Birnie (M.L. 686, Etc.).

Since the above was written, Mr. Harrison, of Boulia, has sent me a collection of specimens from the mine. From these it is inferred that the country in which the ore-bodies occur consists of hornblendic schist. In the crop at the main shaft (since deepened), cuprite is found, gradually shading into limonite and coated with chrysocolla. At shallow depths earthy malachite, sometimes intimately mixed with chalcocite, is found, and at 30 ft. beneath the surface massive metallic chalcocite, carrying crystals of pyrite, appears. Masses of chalcopyrite occur in the schist between 54 and 86 ft. depths, being accompanied by leached pyrite and coated with earthy chalcocite for the lowest 10 ft. (where the body is 3 ft. wide).

Rich specimens, showing intimately mixed chalcocite, malachite, and limonite, sometimes with coatings of chrysocolla, have come from Nos. 2, 3, 5, 6, 7, and Green's shafts, metallic chalcocite from 10 ft. depth in No. 7 shaft also exhibiting disseminated chalcopyrite.

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Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

(B. DUNSTAN, F.G.S., ACTING GOVERNMENT GEOLOGIST.)

PUBLICATION NO. 205.

SECOND REPORT

OAKS VIEW GOLD MINES

(NEAR ROCKHAMPTON).

WITH THREE PLANS AND TWO PLATES.

AND

NOTES ON THE MINES

TALGAI AND THANE'S CREEK GOLDFIELDS.

By LIONEL C. BALL, B.E.,

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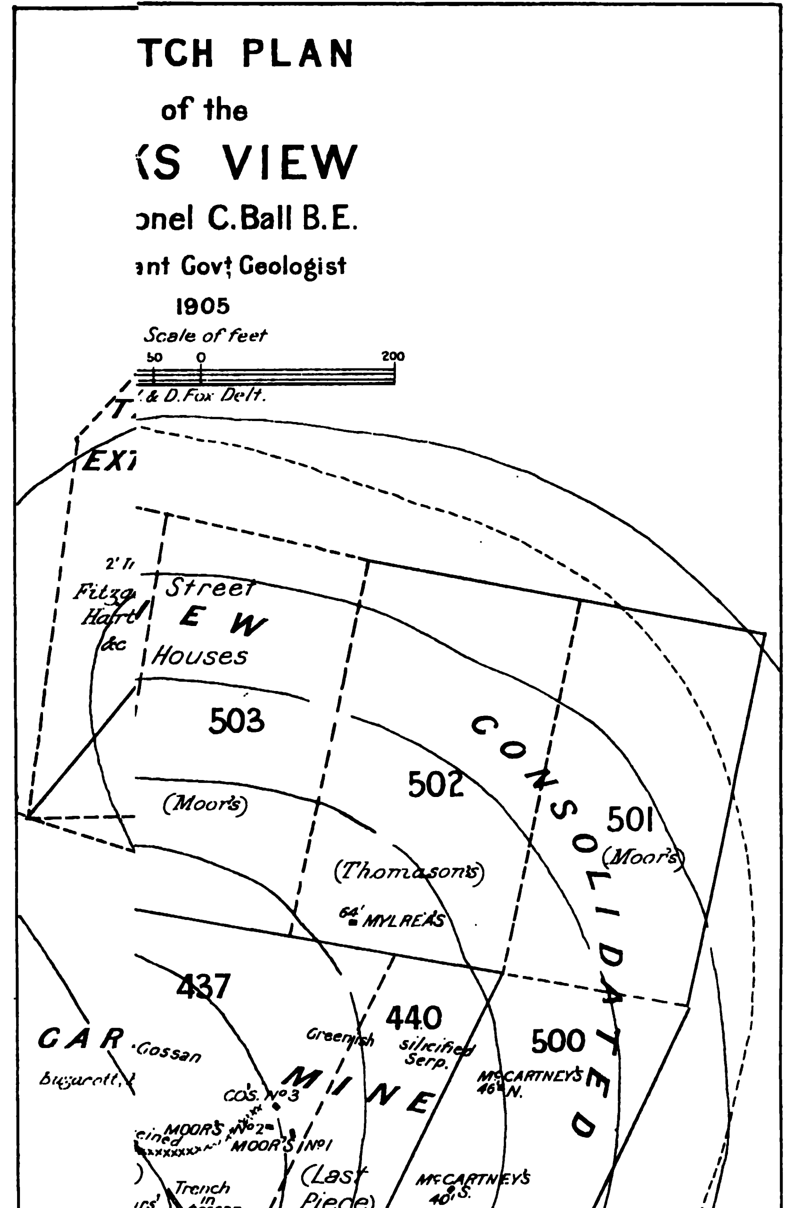


TCH PLAN
of the
(S VIEW
onel C.Ball B.E.
ınt Gov† Geologist
1905

Scale of feet

'.& D.Fox Delt.

THE OAKS VIEW GOLD MINES.

◆

I. INTRODUCTION.

Oaks View Hill, on which the claims are located, is on Grazing Farm No. 1v, Canoona, which is distant from Rockhampton 45 miles by road. Further particulars as to locality, topography, history, &c., will be found in a previous report.*

The population of the field at the beginning of September, 1905, was estimated to be eighty men, women, and children.

The Oaks View Hill, being outside of any goldfield, the ground can only be taken up and held as ordinary claims, under the regulations of the Mining Act, by possessors of miners' rights. Amalgamation of these ordinary claims (200 feet by 400 feet) has now been carried out. The resultant extended claims are ten in number, and cover an area 1,800 feet from north to south and 2,800 feet from east to west.

There has been considerable agitation to have the workings included in an extension of the Canoona Goldfield, which would allow of leases being taken up under a more satisfactory tenure. The employment of two-thirds of the number of men (twenty-four) now compulsory would then fulfil the labour conditions.

II. OAKS VIEW GOLD MINE (No. 441).

(The Oaks View Gold Mining Company, Limited).

1. Area.

This extended claim comprises:—

(*a*) No. 423, the combined reward claim and attached ordinary claim (700 feet by 400 feet), on the former of which are the main or western workings.

(*b*) No. 438, the "Crown of the Hill" (300 feet by 400 feet), on which there are no workings.

(*c*) No. 437, the "Eva" (300 feet by 400 feet), on which are the eastern workings.

(*d*) No. 440, the "Last Piece" (100 feet by 400 feet), on which there are no workings.

These extend from west to east along the brow of the Oaks View Hill, on the northern side.

---

* Recent discovery of gold at Oaks View, near Rockhampton, by L.C.B., Brisb. By Auth. 1905, p. 11, 2 plates. (G.S.Q.P. No. 199). *Also* Q'land Gov. Min. Jour., Vol. vi. (1905), p. 67.

2. WESTERN GROUND (No. 423).

The term western ground is generally employed locally in referring to the reward claim, there being no workings on the remainder of claim No. 423.

I. WORKINGS.

The main workings are on the north-western slope of the hill, just below the brow. They comprise three shafts, Nos. 1, 2, and 2A, with attached stopes, drives, crosscuts, &c., covering an area 240 feet long and up to 70 feet wide. (*See* Plan 1.)

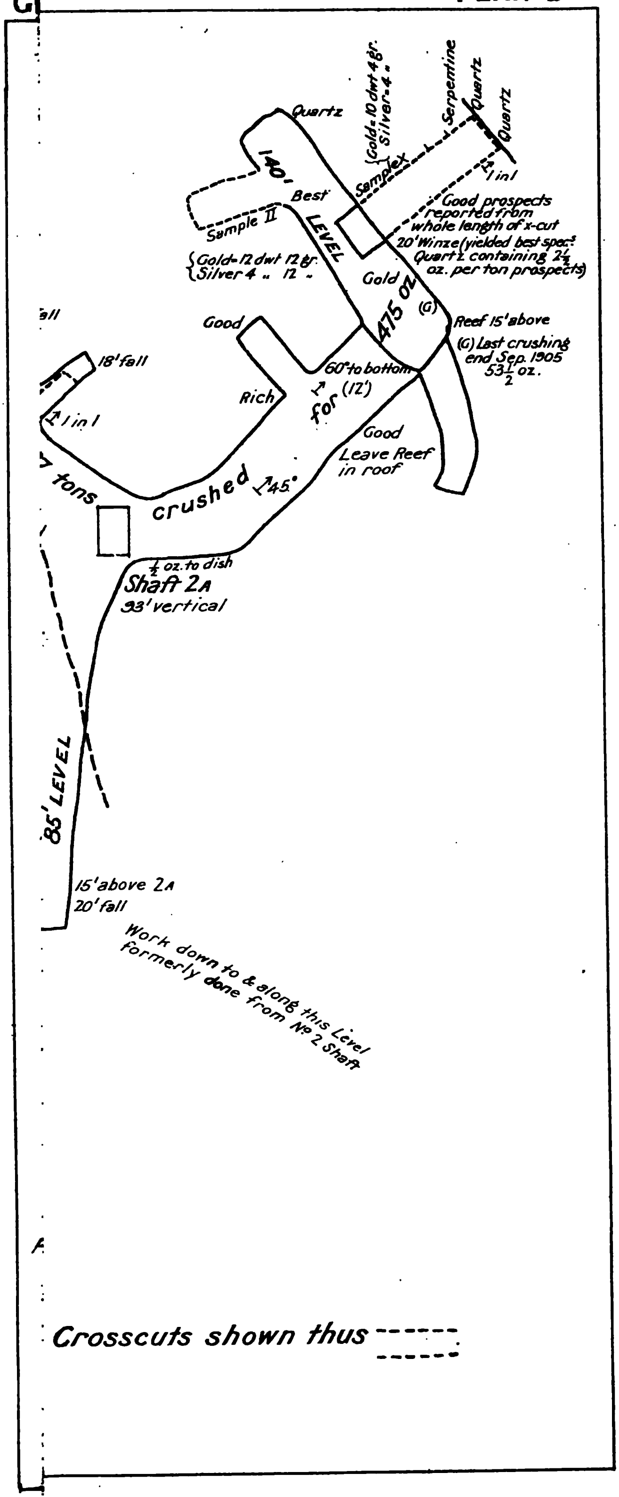
Surfacing.—The surface soil to a depth of two feet has been removed (for crushing) over a distance of a chain west and north of No. 1 shaft. About 2½ chains north-west of No. 1 shaft a trench twelve feet long was sunk to a depth of 17 feet.

No. 1 Shaft (5 feet 6 inches by 3 feet) has been sunk vertically to a depth of 74 feet, the brace being five feet below that of No. 2 shaft. It was, when last seen, only 18 feet deep, but has since been deepened in search of a defined footwall. At a depth of 17 feet the shaft is connected with the stopes now extending downwards and eastwards to the No. 2 shaft (and thence north-eastwards to the No. 2A shaft). Besides the stope, which has an average width of about 25 feet, with a length of 70 feet, there are several radiating drives, with a total length of 150 feet, the positions of which can be seen on the accompanying plan (Plan 2). A crosscut runs 19 feet south 25° west from the bottom of the shaft.

No. 2 Shaft is slightly further up the hillside, the brace being 5 feet above that of No. 1, from which it is distant 54 feet east 6° north. It is 44 feet vertical to the stopes, which continue up to No. 1 and down to No. 2A shafts.

From No. 2 shaft a drive runs due north for 30 feet and south for ten feet. Then an inclined stope, gradually narrowing down to a drive, extends east-north-east for 47 feet, and at the bottom is a prospecting drive running 25° to the south-by-east. Two drives, ten feet apart, run ten feet to the west from the bottom of the inclined stope, and are then connected by an underlie 40 feet in length, from the upper end of which a crosscut extends 15 feet to the west-by-north. From the lower end of this underlie a drive, 40 feet in length, connects with No. 2A shaft, and the ore above it has been stoped out for a distance of 30 feet. Beyond the stope the drive extends 30 feet, and from it two crosscuts branch off, one, 35 feet in length, to the south-west, and one, ten feet in length, to the west-by-north. From the same drive west of the No. 2A shaft two inclines, thirteen and 20 feet in length, have been carried down on the ore, and from the bottom of the latter a crosscut has been carried back to the south-west for ten feet.

PLAN 2


Quartz
Gold = 10 dwt 4 gr. Silver = 4 "
Serpentine
Quartz
Quartz
140' LEVEL
Best
Sample I
1 in 1
Sample II
Good prospects reported from whole length of x-cut
20' Winze (yielded best spec.s Quartz containing 2¼ oz. per ton prospects)
Gold – 12 dwt 12 gr. Silver 4 " 12 "
Gold 475 oz
(G)
Reef 15' above
(G) Last crushing end Sep. 1905 53½ oz.
Good
60° to bottom
18' fall
1 in 1
Rich
for (12')
Good
Leave Reef in roof
tons crushed
45°
½ oz. to dish
Shaft 2A
33' vertical
85' LEVEL
15' above 2A
20' fall
Work down to & along this Level formerly done from No 2 Shaft
Crosscuts shown thus

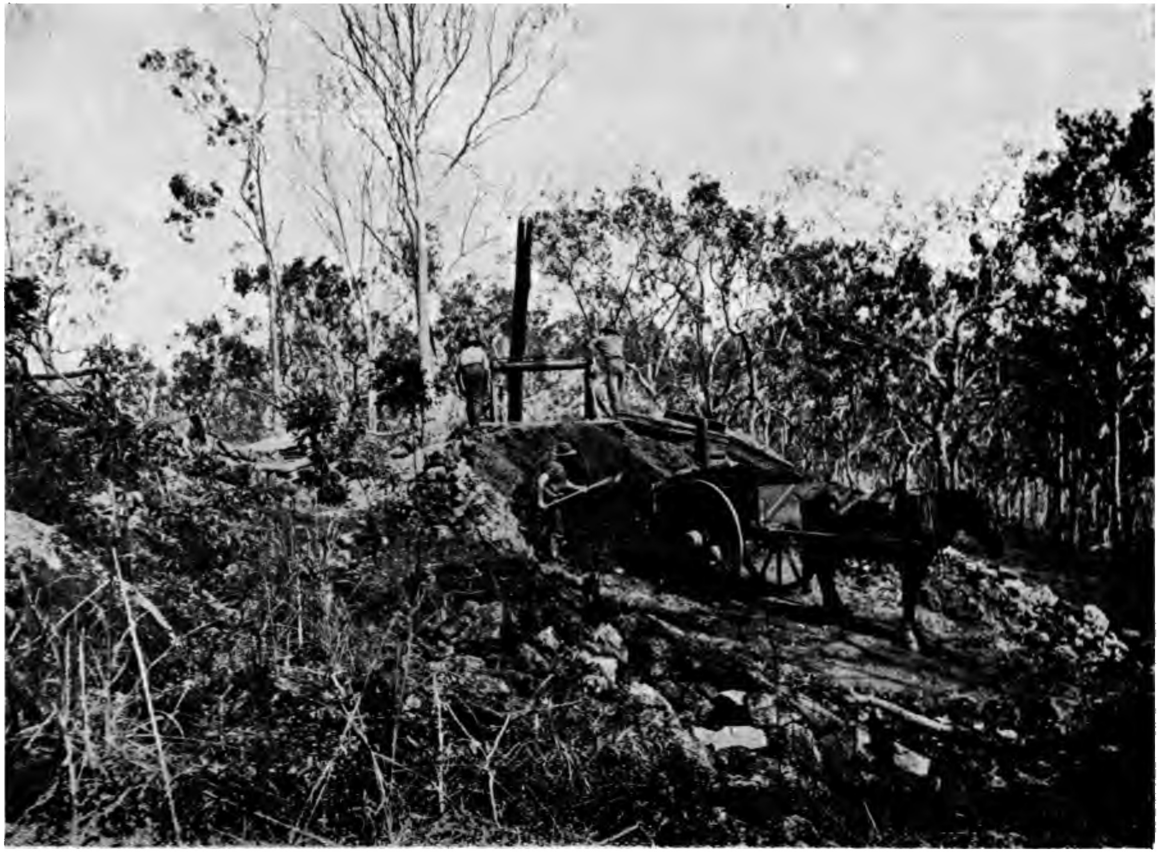


Photo., L. C. Ball. WHIP SHAFT, WESTERN WORKINGS, OAKS VIEW G.M. CO. **Plate 1.**

No. 2a Shaft lies 87 feet north 40° east of the No. 2 shaft. It is 89 feet deep, the brace being 18 feet below that of the No. 2 shaft. (*See* Plate 1.)

From the shaft a wide inclined drive runs easterly for ten feet, and then north-easterly for 30 feet, to a level opened 25 feet to the north-west and 18 feet to the south. At the western end of the level is a ten-foot crosscut to the south, while from the centre of the level a winze has been sunk 20 feet, and a drive carried 20 feet to the north-east.

II. ORE BODIES.

The western workings have proved a shoot of payably auriferous ore to extend from the No. 1 shaft nearly eastwards to the No. 2 shaft, with an average width of 25 feet. Beyond the No. 2 shaft the run has trended more to the north-east. In the No. 2A workings the rich shoot appears to have a width of 30 feet or more. The greatest width proved by stope and drive in the No. 1 workings is 50 feet; in the No. 2 workings 45 feet; and in the No. 2A workings 70 feet; while on the bottom level 40 feet has been exposed.

The method hitherto adopted having been to follow the richest gold, little is known as to the extent of the "pay ore." The thickness may be gauged by the height of the stopes—four to six feet (and even ten feet); and it may be taken to average five feet six inches, varying as it does between four feet in the upper and ten feet in the lower workings.

The No. 1 shaft sinking comprised:—

Gossan, from the surface to 45 ft. depth ...	Occasional colours of gold.
Serpentine (9 ft.) to 54 ft. depth	
Gossan (10 ft.) to 64 ft. depth	
Kaolinised ferruginous serpentine (10 ft.) to 74 ft. depth	

The drive passed from serpentine to gossan within ten feet, and, after three feet, into ferruginous and cherty quartzose ore. This is very promising in appearance, being identical with ground proved rich in the No. 2A workings; but a sample taken by me was crushed and washed for only traces of gold. The dip of the whole is from 45° to 60° to the north-east, so that the belt of serpentine in which sinking ceased should be at least 20 feet thick.

The deeper workings are important, as they prove the gossan and intercalated layers of serpentine to have a thickness of at least 60 feet; and, though poor in the drive, very little additional exploring might reveal rich ore.

The floor of the No. 1 stope is formed by a lenticular layer of serpentine, which cuts out to the north-east of the No. 1 shaft. It is, therefore, within the bounds of possibility that "pay ore" may be found beneath that serpentine.

At 15 feet from the surface in No. 2 shaft, a four-foot quartz reef was cut through, while beneath it was auriferous gossan, which was not properly tested because the shaft was being sunk to the bottom of the

No. 1 stope for ventilation. It is now believed that this gossan is the same as that being worked below No. 2A shaft, and that two distinct gold-bearing layers have been worked—that in the No. 2A workings being an upper, and that in the No. 1 workings a lower. The present workings connecting No. 2 and No. 2A shafts are in country separating the two auriferous zones.

In the No. 2A shaft the lode material was cut, beneath a six-foot quartz reef, at 83 feet from the surface, and was sunk in for six feet. The quartz reef is being left standing, as it forms a splendid roof. It is presumed to be that cut in the No. 2 shaft at 15 feet depth.

The evidence of the workings shows the trend of the ore body to be not towards the eastern workings, but towards the Magazine Rock on the south-east. The network of quartz veins in the serpentine there may be taken to represent the solid quartz vein found in No. 2 and No. 2A workings. It has, however, yet to be proved that the gold persists as well as the gossan and quartz. Some prospecting was done in the vicinity of the Magazine Rock twenty years ago; but, though the ore appears promising enough, the gold is absent, or present only in small quantities. Similarly the work towards the north-west has been discouraging. The stone from the deep trench to the north-west of the No. 1 shaft was crushed for an average yield of 3 dwt. per ton—that on the surface carrying 6 gr. to the dish (1½ oz. per ton), while that beneath decreased in value rapidly. This would indicate that the ore body should be expected rather to the west than the north-west of the workings.

Gossan does occur at intervals between the western and eastern workings, and gold has been found in the soil along the whole of the northern side of the Oaks View Hill; consequently there seems to be more likelihood of gold being found in an east and west belt than along the true strike to the north-west and south-east, but nothing has been done to prove the existence of ore deposits.

III. ORE.

The ore is, in main part, a gossan, consisting as it does of a siliceous framework filled in with ferruginous clay. Patches of unaltered serpentine and flecks of a green chrome-bearing silicate are distributed irregularly through it, and crystalline quartz of two growths can be washed out of the ore from the bottom level. The most promising stone is cellular gossan (palpably leached serpentine), containing streaks of dark-coloured magnesian silicate, and veined to a large extent with granular blue quartz, the thin (⅛-inch) lenticular leaders showing no orientation. The bulk of a ton of gossan, as sent to the mill, has been determined by Mr. O'Meara to be 34 cubic feet.

The reef is simply serpentine, veined and almost entirely replaced by quartz; and that the replacement has taken place along a fissure is indicated by the splendid footwall (and hanging-wall also) with attached polished flucan.

The distribution of the gold in the gossan is very irregular, rich patches being frequently separated by seemingly identical but almost barren ore. The gold cannot be seen in the faces, and its presence or absence has to be proved by sampling and panning off.

The gold from the bottom crosscut (160-foot level) is both fine and granular, the latter being coated by blue-black manganese dioxide or magnesian silicate. The manganese dioxide has often a light blue tinge, and is commonly known at the Oaks View as cobalt. My specimens being packed away, I have not yet been able to test them for cobalt.

IV. SAMPLES.

The following samples were not taken with any idea of valuing the mine, but to test the payable thickness in the lower workings, for it was understood that the whole of the workings, including the crosscuts, were in payable ore. To determine the value of the present faces samples would have to be taken throughout the workings, from roof to floor, at not more than ten feet apart, and this would necessitate the taking of at least 100 samples. It is not certain that a reliable estimate could even by that means be secured, for the richer ore has been broken down and raised, leaving poorer faces, though the ore a few feet inside might be still richer. The occurrence of the gold in patches or bunches adds another difficulty.

Sample 1: From the bottom of the lowest winze (160-foot level) in the No. 2A workings and for six feet along the crosscut; assayed by the Government Analyst:—

Gold, 10 dwt. 4 gr. per ton.
Silver, 4 dwt. ,,

Sample 2: From the whole length (about ten feet) of the southern crosscut on the 140-foot level in the No. 2A workings; assayed by the Government Analyst:—

Gold, 12 dwt. 12 gr. per ton.
Silver, 4 dwt. 12 gr. ,,

Sample 3: From the southern crosscut (35 feet in length) on the 70-foot level; assayed by the Government Analyst:—

Gold, nil.
Silver, trace.

Both samples 1 and 2, it will be seen on reference to the plan attached, were taken from ore over five feet from the quartz reef, that immediately along the reef having been proved (on the 140-foot level) to be still richer. They, therefore, prove a considerable thickness of ore over a limited area to be still payable in the deepest workings. I saw samples from the bottom crosscut washed for 6 gr. to the dish ($1\frac{1}{2}$ oz. per ton) without crushing, and Mr. Apps, the sampler, informed me he got good prospects from the whole length of the crosscut.

With regard to sample 3, the whole length of the crosscut was included, as it differs very little in appearance from gossan proved rich elsewhere, and as I was not informed of the fact that fair prospects were obtained only from the manganese-stained gossan within a few feet of the inner end.

V. OUTPUT.

From the surface:—

345 tons yielded ... ... 85 oz. = 5 dwt. per ton.

Surface to 44-foot level:—

1 ton 12 cwt. dish tailings yielded 19 oz. = 11 oz. 17 dwt. per ton.
160 tons yielded ... ... 305 oz. 4 dwt. = 1 oz. 18 dwt. per ton.

February to December, 1904:—

Prospects washed in dish .. ... 327 oz. 4 dwt.
Making a total of ... ... 651 oz. 8 dwt. = 4 oz. per ton.

44-foot level to 101-foot level:—

318 tons yielded ... ... 342 oz. = 1 oz. 1 dwt. per ton

101-foot level to 146-foot level:—

387 tons yielded ... ... 475 oz. 11 dwt. = 1 oz. 4 dwt. per ton.

Total to the end of September, 1905:—

1,211 tons 12 cwt. yielded 1,228 oz. 15 dwt. = 1 oz. per ton.

The above returns were given me by the manager (Mr. O'Meara). The monthly returns from the secretary (Mr. Catt), which include both eastern and western crushings, are:—

1905, Jan.:	119	tons for	227 oz. 6 dwt.	= 1 oz. 18 dwt.	per ton.
March:	380	,,	130 oz. 14 dwt.	= 6 dwt. 20 gr.	,,
April:	86	,,	62 oz. 18 dwt.	= 14 dwt. 15 gr.	,,
May:	96	,,	34 oz. 0 dwt.	= 7 dwt. 2 gr.	,,
June:	122	,,	267 oz. 0 dwt.	= 2 oz. 4 dwt.	,,
July:	96	,,	202 oz. 10 dwt.	= 2 oz. 2 dwt.	,,
Aug.:	142	,,	128 oz. 0 dwt.	= 18 dwt.	,,
Sept.:	149	,,	144 oz. 17 dwt.	= 19 dwt. 11 gr.	,,
	1,190	,,	1,197 oz. 5 dwt.	= 1 oz.	,,

The value of the gold washed out by the prospecting syndicate was £3 10s. per oz., while that of the ingots sent from the mine varies between £3 10s. and £3 15s., the average being £3 14s. per oz.

3. Eastern Ground (No. 437).

The eastern ground comprises claims Nos. 437 (the "Eva") and 440 (the "Last Piece"), on the the latter of which no work has been done.

I. WORKINGS.

Work was begun by Moor on the "Eva," but some work has lately been done by the company, the location being almost 1,100 feet east of the western workings. (*See* Plan 3.)

Moor's No. 1 shaft is 18 feet deep (vertical), and underlies 1 in 1 for 15 feet.

Moor's No. 2 shaft, 25 feet to the west of No. 1, is really only a few feet deep, but connects with No. 1 at the 17-foot level by an irregular stope.

PLAN 3

SKETCH PLAN

on the plane of the underlie

EASTERN WORKINGS

Oaks View G.M.Co

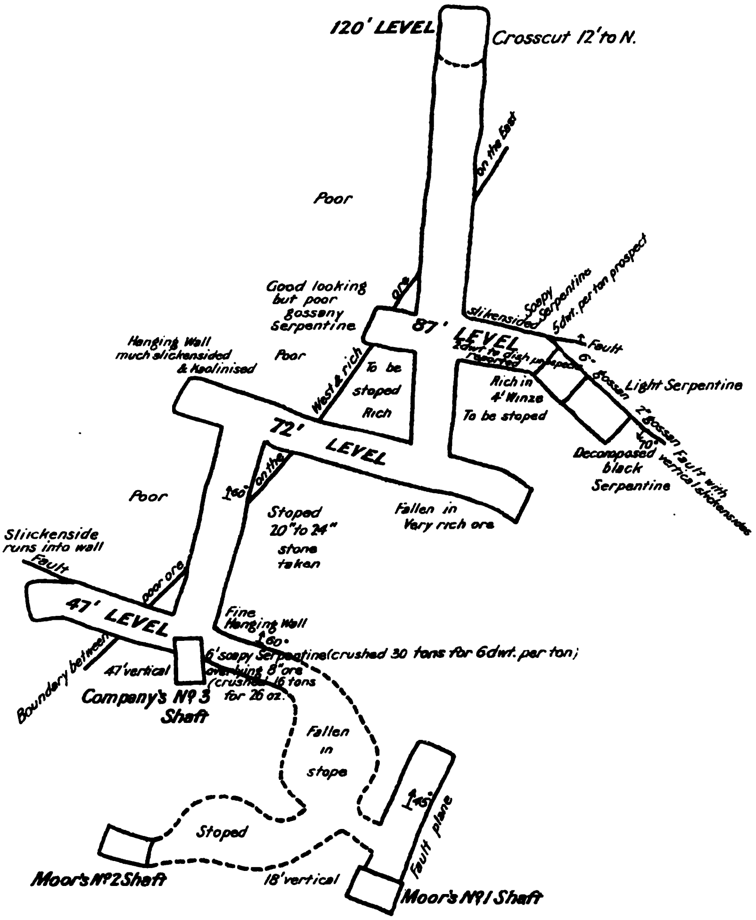
By Lionel C. Ball B.E.

Assistant Govt Geologist

1905

Scale 20 feet to an Inch

20 10 0 20


120' LEVEL
Crosscut 12' to N.
on the East
Poor
Good looking but poor gossany Serpentine
ore
87' LEVEL
slikensided
Soapy Serpentine 5dwt. per ton prospect
Fault
2dwt to dish un specked reported
6" Gossan
Light Serpentine
Hanging Wall much slickensided & Kaolinised
Poor
West & rich
To be stoped Rich
Rich in 4' Winze
To be stoped
2" Gossan Fault with vertical slickensides
70°
Decomposed black Serpentine
72' LEVEL
on the
60°
Poor
Stoped 20" to 24" stone taken
Fallen in Very rich ore
Slickenside runs into wall
Fault
poor ore
47' LEVEL
Fine Hanging Wall
60°
6' soapy Serpentine (crushed 30 tons for 6dwt. per ton)
overlying 8" ore (crushed 16 tons for 26 oz.
Boundary between
47' vertical
Company's No 3 Shaft
Fallen in stope
45°
Fault plane
Stoped
Moor's No 2 Shaft
18' vertical
Moor's No 1 Shaft

The Company's No. 3 shaft, 30 feet north-west of Moor's No. 1, is vertical to 47 feet depth, at which point a level runs 16 feet westwards and 18 feet eastwards to a small stope connected with Moor's No. 1 and No. 2 shafts. The shaft continues northwards on the underlie (at an angle of 60°) for 24 feet to a second level extending five feet westwards and 25 feet eastwards. From this level, at 17 feet from the underlie shaft, an underlie winze descends 48 feet, there being levels five feet west and 22 feet east and south-east at 14 feet below the 72-foot level.

Much of the stone hitherto crushed has come from the stope between the 47-foot and 72-foot levels.

II. ORE BODY.

The eastern workings are located upon a single shoot, which pitches towards the north-east. The width of the shoot was 24 feet on the 47-foot level and 30 feet on the 72-foot level, but on the 87-foot level only 15 feet has yet been proved. The thickness of ore broken down between the 47 and 72 foot levels was from 20 to 24 inches.

In the Company's No. 3 shaft the sinking from 12 to 20 feet was through cherty country, beneath which is four inches very rich, soft, clayey, gossany slate and ironstone, dipping north-easterly; gossany material underlies this to the shaft bottom.

On the 47-foot level, however, no fault can be seen between the ore body and the solid black serpentine footwall, and none between the ore and the crushed serpentine on the hanging-wall, but a well-defined fault plane separates the crushed serpentine from the overlying rock.

The lower workings are undoubtedly on a line of faulting, the foot and hanging walls both having considerable slickensides and flucan.

On the 87-foot level some confusion has been occasioned by an oblique fault from the south-east, which has been followed instead of the main fault, the gold having in consequence been lost. This fault shows strong vertical slickensides.

Both hanging-walls and footwalls in the lower levels are crushed (slickensided) serpentine.

A black manganese-stained siliceous skeleton, forming a vein from two to eight inches thick, and at any distance within six feet of the fault, but generally forming a footwall for the auriferous ground, is looked upon as an " indicator " here.

III. ORE.

The ore is similar in appearance to that at the western end, the original serpentine having been, however, not quite as thoroughly leached and altered.

Much of the gold here occurs painted on the " faces " of fissures in the serpentine and ferruginous slate. Rich gold has also been found in the flucan of the hanging-wall on the 81-foot level; and on the 47-foot level six feet of crushed soapy serpentine, having to be removed, was milled for a return of 6 dwt. per ton.

IV. OUTPUT.

22 feet to 84 feet:—

52 tons for 61 oz. 10 dwt. = 1 oz. 4 dwt. per ton.

Lowest portion of stope and 24-feet level:—

October, 1905—22 tons for 45 oz. 10 dwt. = 2 oz. 1 dwt. per ton.

47-foot level:—

16 tons for 26 oz. = 1 oz. 12½ dwt. per ton.
30 tons for 9 oz. = 6 dwt. per ton.

4. EXPLOITATION.

The ore has hitherto been got with little or no system. A shaft was first sunk in the outcrop of the western ore body. Samples were then taken from the face and panned off without a preliminary crushing, a drive (sometimes opening out into a stope) being then opened on the side where the richest prospect was found. Each day the faces were prospected by sampling (three dozen places sometimes), and the direction of the work altered accordingly, so that even now some parts of the workings have much resemblance to a rabbit warren. When ventilation became impaired and haulage began to become difficult, a second shaft was sunk to the lowest end of the first workings, and work was then continued to the dip. Thus, shafts Nos. 2 and 2A have been put down, and it seems likely that another will soon be required. Drives and inclines (located on richer strings of gold) branch out from the stopes in all directions, and six crosscuts have been carried back into the poorer gossan in search of a footwall.

Three shifts are now at work in the bottom crosscut, each containing two men picking down the ore, one man filling the greenhide buckets at the shaft, and two men on the brace hauling. There is a sampler on the day shift, and when work is going on fully four additional men are employed in the mine.

As mentioned elsewhere, the samples taken daily in the mine are washed without a preliminary crushing, it having been found (by crushing check samples) that, if the prospect is poor from an uncrushed sample, the crushed ore will give a result very little better. Most of the gold must, therefore, occur in the soft earthy portion of the ore, and not in the quartz veinlets.

Just previous to my visit exemption had been secured, because of the want of water, but an opportune storm had replenished the dam, and crushing had been resumed, though only partial work was going on in the western ground, and none in the eastern.

5. TREATMENT.

I. TRANSPORT.

The ore is raised in greenhide buckets by windlass, and is carted from the shafts down the hill to the boundary of the machine area, where it is tipped on the ground. It has then to be loaded on a small trolly running on rails to the automatic feeders. It is thus evident

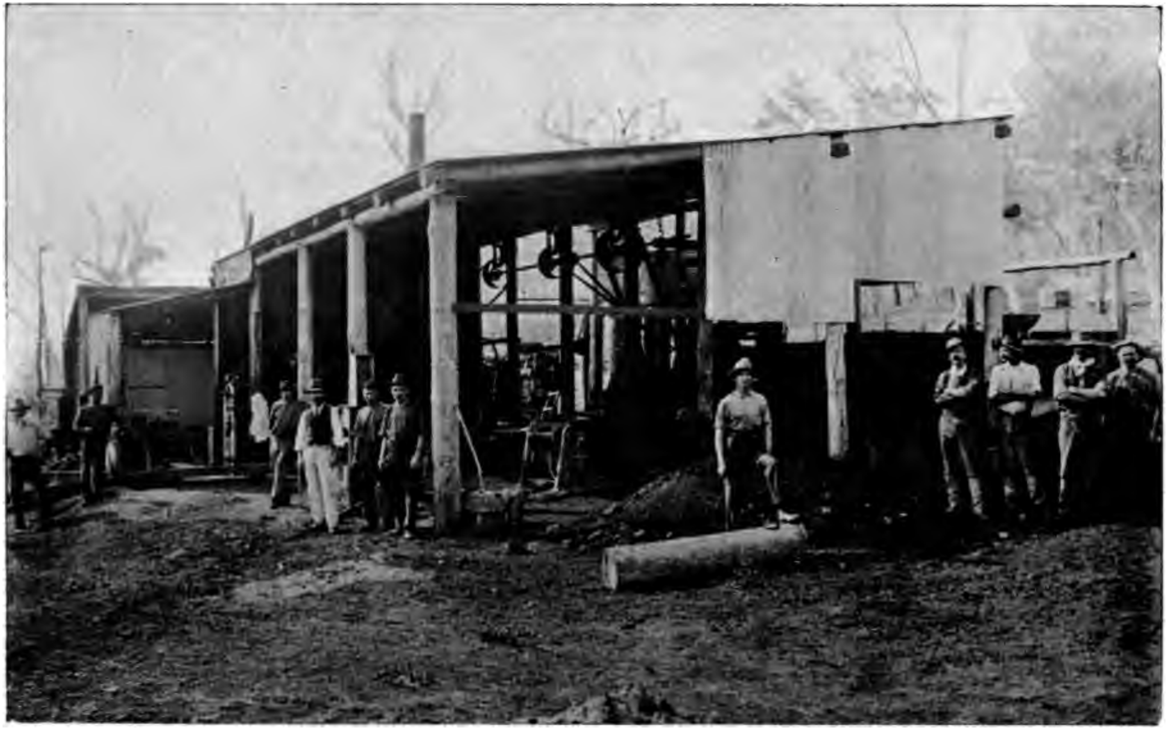


Photo., L. C. Ball. CRUSHING MILL, OAKS VIEW G.M. CO. **Plate 2.**

that there is abundant room for improvement. The construction of a double tramway to the western workings will, of course, be undertaken sooner or later, and the erection of storage bins at the mill is a matter of prime importance in the reduction of costs.

II. MILLWORK.

The mill consists of one five-foot Huntington mill (with five discharge openings with screens having thirty meshes to the linear inch) in operation, and one (with three openings) in course of erection. The mill is provided with "Challenge" automatic feeder, and is now putting through about ten tons a day (this being one-half its capacity, running at 52 revolutions per minute), but the rate is varied according to the richness of the ore. Copper-plate tables are provided for the mills, but it is found that 85 per cent. of the gold is amalgamated in the mill itself, owing to the extended trituration. It is believed the gold is slightly coated.

The mills are found to give perfect satisfaction with the gossany ore, but with the quartz the mullers are worn too rapidly.

A partial clean-up is made once a week, the amalgam being then removed from the well and fresh quicksilver added.

The average contents of the tailings, now amounting, approximately, to 1,500 tons, is 1 dwt. 4 gr. per ton. The slimes were expected to be slightly richer, and were, therefore, saved, but a 200-ton trial by cyaniding proved them to carry only from 1 dwt. 4 gr. to 1 dwt. 8 gr. per ton.

The mills are driven by a 20-h.p. (44 I.H.P.) semi-portable boiler and engine (two 10-inch cylinders with 14½-inch stroke), capable of running three 5-feet mills.

The cyanide plant consists of two galvanised-iron tanks 15 feet in diameter and three feet six inches high, and one ten feet in diameter and five feet high (sump).

The men employed at the mill (for three shifts) comprise three drivers, three feeders, a woodcutter, and the manager.

The question of a water supply has occasioned some trouble here. That first obtained from shallow wells proved very limited in quantity, being derived entirely from sub-soil drainage; and, in consequence, a dam had to be excavated. This has an average diameter of 2½ chains, and an average depth of four feet, its capacity being 900,000 gallons when full, that being sufficient to keep the mill going for four or five months.

The water is pumped from the dam by a Worthington duplex pump, and is returned to the dam again from the settling pits. A Tangye pump, with Tonk patent valve, is installed in the well.

In order to supplement the dam supply, a six feet by six feet well was sunk adjacent to the mill to a depth of 24 feet, and a drive, intended to be 100 feet in length, has been opened out 18 feet under the flat on the north. The quantity being raised (6,000 gallons per 24 hours) about equals the loss from evaporation in the dam.

III. OAKS VIEW CONSOLIDATED (No. 517).

1. Area.

The Oaks View Consolidated (claim No. 517) adjoins the Oaks View on the north and east, and comprises claims Nos. 508 (originally Nichol's), 507 (originally Cohen's), 506, 505, 503, 502 (originally Homeward's and Mylrea's), 501, and 500 (originally McCartney's). It is now held by the Oaks View Gold Mining Company, but all the work on it was done by the former holders.

Workings are to be seen on Nos. 508, 507, 502, and 500; but none of the shafts could be descended. On Nos. 506, 505, 503, and 501 practically no work has been done, even in prospecting the surface.

2. Nichol's (No. 508).

Workings.—Nichol's shaft (41 feet below No. 2) is situated 260 feet north-north-east of the No. 1 shaft on the reward claim.

It is now inaccessible (having been abandoned because of water trouble), but is reported to be 118 feet deep. Water-level is at 102 feet beneath the surface. The Company has done nothing on this ground, but the manager intends to put men on to prove it as soon as circumstances will permit.*

Ore Body.—It is understood that this shaft passed through a quartz reef into an ore body similar to that in the western workings (on the reward claim). The ore on the surface, said to have come from 118 feet depth, is identical in appearance with that in those workings, and good prospects of fine gold can be washed from it. The ore bodies of the reward claim should not, however, be struck here at much less depth than 200 feet from the surface, unless a very considerable flattening takes place.

3. Cohen's (No. 507).

Workings.—Cohen's shaft, 45 feet below No. 2, lies 360 feet east-south-east of Nichol's. The reported depth is 130 feet. The shaft is inaccessible, work having been stopped because water was struck.

Ore Body.—The sinking seems to have been in light brown and sometimes greenish altered serpentine. The last few bucketsful raised consist of leached, quartz veined, and banded black gossan, which carries very good prospects of flour gold. Flour gold (which is considered a good sign) was reported at a depth of 120 feet, and "colours" between 100 and 130 feet. It is to be hoped that further prospecting work will be undertaken here, both in the ore found and in further sinking the shaft.

---

* December, 1905: Mr. O'Meara informs me he is driving S.W. at 100 feet depth.

4. MYLREA'S (No. 502).

Workings.—Mylrea's shaft is 210 feet north-north-east of the company's No. 3 shaft (at the eastern end). It is 64 feet deep.

Ore Body.—Though gossany, quartz veined, and replaced serpentine has been raised, from below ferruginous serpentine in the sinking "pay ore" has not been reported.

5. McCARTNEY'S (No. 500).

Workings.—The northern shaft lies 230 feet east by north of the company's No. 3 shaft. It is 46 feet deep.

The southern shaft, 110 feet to the south-south-west, is 46 feet deep.

Ore Bodies.—The northern shaft was sunk to a blue quartzite (replaced serpentine) in the gossan, above which gold has been found. Chalcedony, zoned and faulted, and also magnesite, are to be found on the tip from this shaft.

The southern shaft is understood to have been sunk on the division between auriferous stone (fair prospects), and serpentine for 18 feet at least above bottom. The serpentine at bottom dips north-eastwards.

IV. FEDERATION AMALGAMATED (No. 490).

The claim is irregular in shape, being 400 feet wide and 500 feet long. It includes the ground formerly held by Hyde and Clark and Hinze and Pacey, and adjoins the reward claim on the west. The claim, being under exemption, was unmanned when inspected, and of the shafts only Hinze's and Pacey's could be descended.

1. HYDE'S AND CLARK'S.

The shaft (about 25 feet below No. 2 of the Company), in the north-eastern corner of the claim, was abandoned at 105 feet, because of water inflowing.

At 20 feet (?) depth, 20 feet of quartz and quartz-veined country (which outcrops about 50 feet up the hillside) was struck. The quartz is cherty, with bluish manganese stains, and contains green silicates. Prospects of gold were found, so it was paddocked, but a surface sample of the quartz in the paddock (believed to carry 7 dwt. per ton) yielded (Government Analyst):—

Gold, Nil; Silver, Trace

The gossan was not sampled, though reported to be auriferous.

2. EVA'S.

The shaft is near the centre of the reward claim boundary, and was, in fact, sunk by the prospectors. It is twelve feet deep.

A sample was taken from the gossan thrown out of the shaft and panned off for a trace of gold.

3. Clark's.

The shaft lies about a chain west of Eva's. It is only a few feet deep.

A sample of the gossan on the brace was panned off, but yielded no gold.

4. Hinze's and Pacey's.

The shaft (about 25 feet below the company's No. 2) is located in about the centre of claim No. 490.

It is vertical for ten feet from the surface, and then underlies at 75° (to the north 25° east) for 40 feet. Levels have been commenced at 20 feet, 30 feet, and 45 feet from the surface (15 feet, 25 feet, and twelve feet in length). The proposal for the future is to sink a shaft 50 feet to the north of the present one, to cut the reef at a slightly greater depth than the underlie workings.

A couple of feet of gossan forms the hanging-wall; this is altered serpentine, and is very promising in appearance, but it contains only odd colours of gold. Beyond this is two feet of slickensided rotten serpentine, with laminated green chrome (?) silicate, and then gossan again. The footwall is also formed by gossan.

The reef is very bulgy, varying from six inches (or less) to six feet in thickness, while the average is two feet. There is no sign of fissure, except occasionally centrally in the vein. The footwall is unusual, in that it breaks from six inches to a foot into the reef every few feet as the descent is made, while the hanging-wall remains unbroken.

The quartz is sometimes similar to that in the No. 2A workings, in being cellular. It contains solid limonite and bunches of green chrome (?) silicate. The best gold is found where the reef is thin. A test was made in the Oaks View United mill of—

13 tons, which yielded $\frac{1}{2}$ oz. per ton.

and 40 tons of similar stone now lies at grass, as $\frac{1}{2}$-oz. stone would not pay to work on a small scale.

V. O'MEARA'S (No. 513).

The claim is 200 feet by 400 feet in area, and adjoins the reward claim on the north, and the Consolidated on the west.

The only work (the sinking of about a dozen shallow shafts (4 feet 6 inches by 2 feet) hitherto done has been in search of alluvial, in a small gully running northwards from the western workings.

Near the reward claim the gold is found at a depth of from three feet to eight feet, but on the flat nearer the battery it is being found at 16 feet beneath the surface. No defined run has been found, but the whole of the gold is believed to be within the confines of the claim, the lowest shaft being a duffer. The gold is fairly coarse ($\frac{1}{4}$-inch diameter), is only slightly rounded, and has evidently been shed from the western ore body. Only 1$\frac{1}{2}$ oz. had been saved at the end of October, 1905.

VI. TARCOOLA (No. 518).

Claim No. 518 is 400 feet by 400 feet in area. It adjoins the north-western corner of the reward claim.

The only work done on this claim has been the sinking of three holes to six feet depth. In one of them there is said to be a leader, but only slate and quartzite are now exposed, though occasional fragments of gossan (said to be auriferous) are found in the soil. The ground is probably held for the purpose of proving at a depth any deposit that may be brought to light on the adjoining Federation Amalgamated.

VII. TARCOOLA EXTENDED (No. 519).

This claim has the shape of a rhomb, with sides 400 feet in length. It adjoins the Tarcoola and Federation Amalgamated on the west.

In the eastern corner a two-foot trench has been opened across a quartz outcrop, the total width of which is 17 feet 6 inches. The quartz, much of which is slightly chalcedonic, is evidently replaced serpentine, and differs from that in the western workings on the reward claim, which is only partly replaced. A sample was taken from the whole length of the trench, but yields (Government Analyst):—

Gold, Nil; Silver, Trace.

The hanging-wall side of the reef is beautifully polished, proving it to be on a line of movement of some extent. Its dip is 42° to the north 50° east. It is thus probably the same reef as worked in Hinze's and Pacey's shaft on the Federation Amalgamated. Adjoining the reef on the north-east is 2 feet 6 inches of rotten, green, silicate-bearing serpentine, under a six-inch leader. This seems more likely to prove auriferous than the reef itself, and prospecting (with the dish) of the surface soil along both sides of the quartz reef is therefore advised.

VIII. GARDEN.

This claim, 400 feet by 800 feet in area, is the last pegged out. It lies south of the Federation Amalgamated, and west of Penhallurick's Extended Gold Mine No. 4.

No work has yet been done here.

IX. PENHALLURICK'S EXTENDED GOLD MINE, No. 4.

The claim is 400 feet by 200 feet, and is situated at the south-western end of the reward claim.

No work has yet been done here.

X. BEEHIVE.

The area of this claim is 400 feet by 400 feet. Its location is adjacent to the south-eastern corner of the Oaks View, and south of the Consolidated.

There is a trench in ferruginous serpentine in the north-western corner, and a trench was being made in the centre of the claim when I left the field, but it had not then passed through the soil.

XI. OAKS VIEW SOUTH EXTENDED UNITED GOLD MINE

(No. 514).

The claim is generally known as Penhallurick's. It has an area of 800 feet by 400 feet, and adjoins the Oaks View Gold Mine on the south. Only southern slopes of the Oaks View Hill are included within its limits.

The only prospecting work done on this claim has been the opening of a few trenches near the hilltop, just within the northern boundary. The gossany and quartz-veined outcrops here are promising enough, but I am not aware of any gold having yet been found.

The original prospectors of the "Crest of the Hill" sank a shaft to a depth of 20 feet on the hilltop, in what is now the north-eastern corner of this claim. They found only light, rotten serpentine.

The present holders are now opening an adit half-way down the hillside, in the eastern part of their ground in the hope of striking, within 300 feet, the extension of the ore body of the reward claim.

XII. TINKER'S HILL.

Tinker's Hill, a mile north of the Oaks View Hill, received attention from a party of prospectors, and was, therefore, inspected. It consists chiefly of schist and quartzite, and the only trench opened is in an outcrop of the latter rock. Colours were once reported, but no gold can now be found, and the claim is expected to be abandoned.

Black's Hill lies ¾-mile east-north-east of Tinker's Hill. It is composed of ferruginous shale and quartzite. Colours of gold were said to have been found on it, but no confirmation can be had of the rumour.

30th November, 1905.

NOTES ON THE MINES

TALGAI AND THANE'S CREEK GOLDFIELDS.

By LIONEL C. BALL, B.E.,

ASSISTANT GOVERNMENT GEOLOGIST.

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NOTES ON THE MINES

TALGAI AND THANE'S CREEK GOLDFIELDS.

◆

INTRODUCTION.

The following notes were prepared while on a brief visit to the fields in August, 1905:—

On the return journey a correction was made in the delimitation of the granite area on the Warwick-Goondiwindi Railway, such area being observed to extend between the 17½-mile peg (two miles beyond Cunningham) and the 22¾-mile peg (one mile before reaching Thane). The granite is a typical coarse biotite variety, apparently occupying the floor of the wide, flat, fertile valley stretching some six miles south of the railway. The glimpses of the cuttings obtainable from the moving train point to the granite being intrusive in the slates and quartzites of the Thane's Creek and Talgai Goldfields. To this intrusion may naturally be ascribed the occurrence of the reefs in the slates, which may, therefore, become more permanently defined as the granite is approached.

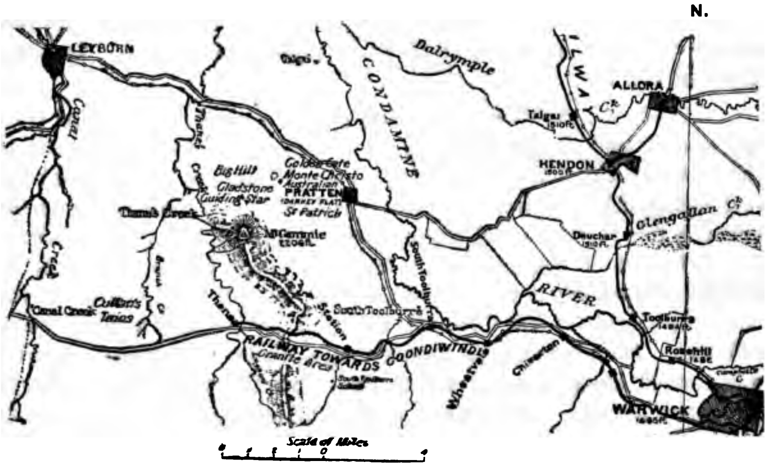

FIG. 1.—LOCAL SKETCH, SHOWING POSITION OF CULLAN'S TWINS, ETC.

MONTE CHRISTO, ETC.

The Monte Christo lease adjoins the Big Hill lease on the south, and lies about three miles west of Pratten, the commercial centre of the Talgai Goldfield.* The present holders bought the property from the liquidators of the Pratten Gold Mining Company.

Within its boundaries three lines of reef have been worked, and there are still other outcrops.

1. Monte Christo.

An application was made in July, 1905, for Government assistance to the extent of £300 to continue the new vertical shaft from 174 feet to 270 feet, at £4 per foot, and to crosscut north and south. In my report on that application I advised that prospecting should first be done on the reef where exposed in the old workings.

New Workings.—The new vertical shaft (begun in 1903 because the old workings were then inaccessible and believed to be unsafe) is 6 feet by 3 feet, part timbered, of two compartments, and provided with windlass and whip. It lies 2½ chains distant to the south 20 degrees west from the fifth shaft from the eastern end of the Monte Christo workings. In it the only change (from grey, sandy, slate grit) is at 25 feet from the bottom, where there is a one-foot band of white kaolinised rock, dipping 40 degrees to the south-east. This indicates the proximity of the Monte Christo reef and leaders. Taking everything into consideration, my calculations indicate that the reef should be struck at about 18 feet below the shaft bottom—*i.e.*, at a depth of 192 feet.

Old Workings.—The only shaft now accessible is the third from the eastern end of the workings, and lying north 44 degrees east of the new vertical shaft. It is vertical for 26 feet, at which point the reef was struck, and from which it was followed to the bottom on the underlie for 15 feet at 56 degrees (then stopes lying on both sides), for 15 feet at 35 degrees, for 20 feet at 45 degrees, for 30 feet at 53 degrees (stoped only down ten feet), and for ten feet at 35 degrees to the bottom (several (!) feet filled in), the total vertical and underlie being 117 feet. The angle of dip thus averages about 45 degrees. A drive was carried along the reef to the east from the foot of the underlie for about 50 feet, where, on a local bend, the dip is 63 degrees to south 20 degrees east. About 33 feet from the underlie is a stepped winze 20 feet deep, the bottom of which is connected with the eastern shaft (90 feet from that last descended). From this eastern shaft a crosscut 165 feet in length runs out to the south, in the search for a large but poor reef, to be seen on the surface near the shaft.

At 60 feet vertical depth is a crosscut in the hanging-wall, in which at 30 feet from the underlie a leader dipping 40 degrees to south-west was met. A big chamber has been excavated at the level of the bottom of the main underlie, though it is reported that the leader was generally only a few inches thick. It is probable that branch leaders proved auriferous near the main leader.

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* See late Discovery of Gold near Pratten, Talgai Goldfield, &c. (G.S.Q.P. No. 186.)

Reef.—The Monte Christo reef near the top of the underlie is seen to be only two inches thick, but at the eastern end of the 117-foot level is twelve inches and more, of hungry, glassy quartz. At the foot of the shaft there seems to be a branch running off into the hanging-wall. The reef is 18 inches thick at the eastern underlie, and on the level connecting this shaft with the winze one to three feet of iron-stained quartz is exposed, dipping about 45 degrees. A small sample taken by me gives (Government Analyst)—

Gold	19 gr. per ton
Silver	1 dwt. 19 gr. per ton

It is, however, said that the gold was not found in the main reef, but in the stringers bulging off into the hanging-wall, so that the poverty of the above sample must not be taken as altogether condemnatory. In order to test the reef, the whole of the drives and faces should be cleaned up and sampled. Then the underlie should be continued, and drives carried along the reef.

Output.—The total recorded output from the reef is very small. Mr. Rands* gives the yield from 1866 to 1897 as—

244½ tons for 1,222 oz. 3 dwt. = 5 oz. per ton.

The country rock over the greater part of the workings is a white, sandy, kaolinised slate—probably slate altered by thermal solutions—but at the eastern underlie the hanging-wall rock is bluish-mottled slate, very similar to that at 174 feet depth in the new vertical shaft. Further out along the crosscut thin bedded quartzites can be distinctly seen to dip 65 degrees to south-south-east. The reef may, therefore, be on a strike fault.

2. WELCOME STRANGER.

These workings lie 300 feet to north 255 degrees east of the new vertical shaft referred to in the description of the Monte Christo.

Workings.—The two shafts—the prospecting and whip—lie 44 feet apart on a west 10 degrees south line, the former 15 feet deep and the latter 70 feet. The Pratten Gold Mining Company sank the prospecting shaft several feet up the hill—*i.e.*, to the eastward of where the original patch of gold was found on the surface. A well-defined twelve-inch lode was struck at 15 feet depth, and was followed on the underlie to 50 feet depth. At this point the present holders broke down several tons. They then, on the east, sank the vertical whip shaft to 70 feet, and from the bottom opened an inclined stope for 25 feet to the east, reaching five feet below the shaft bottom. In the eastern face of this stope is a crosscourse striking north 15 degrees west, and dipping 85 degrees to west 15 degrees south, and this crosscourse cuts off a large body of barren quartz.

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* Big Hill Gold Mining Company's Lease, Talgai. By W. H. R. 1898. Bris.: By Auth. (G.S.Q.P. No. 128.)

Reef.—In the prospecting shaft the lode is plainly twelve inches wide, but in the whip shaft only two inches of rubbly quartz and limonite was cut. It is, on the whole, vertical, any inclination observable being to the north. The footwall is good, but there is no sharply-marked hanging-wall. The auriferous stone in the company's stope generally followed (lying about six feet above) a floor dipping to the east. The shoot was very flat, its inclination being only about one in four horizontal; and it is therefore probable that the whip shaft has been sunk through it. The lower stopes are therefore below the general run of the gold, for the flat floor referred to crosses the shaft above those stopes. One patch of gold was, however, found in the whip shaft below that floor. Wherever gold was found the enclosing material was clayey, and it was always moist. The metal is also generally associated here with ironstone.

Output.—The output of the Pratten Gold Mining Company is understood to have been 68½ oz., chiefly from two or three pockets in the stope below the prospecting shaft. At 62 feet depth in the whip shaft a patch of 100 oz. of gold was found in a three-inch band of rotten rock, and 3½ tons of stone secured from the vicinity yielded 20 oz. 8 dwt. of gold, valued at £3 19s. 6d. per oz.

The value of the gold won hitherto is about £750, while the mining costs probably did not exceed £200. The property should therefore be worth developing to some extent by sinking and blocking out, instead of opening out large chambers without method, as was done below the whip shaft in the search for bunches.

3. CLARE'S.

This reef passes within three feet of the brace of the new vertical shaft on the Monte Christo lease, and should be cut by a 60-feet crosscut to the south on the 174-feet level, but it has not been sufficiently prospected on the surface to encourage the project of crosscutting.

A shaft on the reef, 17 feet deep, lies 41 feet to the south 75 degrees west of the new vertical. In it is exposed nine inches to twelve inches of solid white pyrite-bearing quartz, with two inches of limonite and bluish quartz against a rotten slate footwall, dipping 70 degrees to south 2 degrees east. A sample from the bottom of the shaft yields (Government Analyst) only traces of gold and silver, but that does not prove the reef unworthy of further testing.

An old shaft adjacent to the above is said to be 40 feet deep, and to have given several small crushings.

GOLDEN GATE.*

This five-acre lease lies adjacent to the Monte Christo, on the eastern side. The workings lie in the south-western corner, and have been all carried out since my last visit. The reef was discovered by prospecting the soil with a pan, the twelve-inch outcrop, two chains west of the present workings, being presumably poor.

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* See G.S Q.P. No. 186.

Workings.—These workings comprise two shafts 54 feet apart, the eastern (or prospecting) shaft being 30 feet deep, and the western (or whip) 60 feet deep. The shafts are connected at the bottom by an inclined crooked drive, and also at the 20-foot level. The ground between the shafts has been irregularly stoped to the surface. Further sinking is necessary, with drives east and west, and it will probably be necessary to break down several feet of interlacing leaders and country rock.

The prospecting shaft was begun in the footwall, and struck the reef dipping south-eastwards at ten feet. After a few feet the reef became vertical. It here consists of six feet of altered country, traversed by a network of leaders.

The whip shaft was begun in the footwall, and at a depth of 20 feet struck the reef dipping north-westwards.

Reef.—The workings show that there is here a band of altered country (running west 30 degrees south, and practically vertical), with numerous quartz leaders six inches or less in thickness, one or more of which may be auriferous for some yards till intersected by another, which then carries the gold till crossed again itself. Small lenses of quartz beside the main leaders are sometimes found to be gold-bearing. The reef along the bottom workings is poor, but as the owner was unwilling to have it sampled I cannot give the contents.

The presence of a slickensided plane indicates that the leaders are on a fissure zone, conforming in many particulars with the Monte Christo, especially in the country rock, which in the vicinity of the auriferous shoots is brown decomposed sandy slate, but westwards is white clayey, with small nodules of unaltered quartzite.

Ore.—The quartz is glassy, some of it pink, some blue, and some white, but all emitting, when freshly broken, a distinct odour of sulphuretted hydrogen. It has a banded appearance, and seems to be in process of replacing the country rock. The best gold is found where there are strong dendritics (manganese dioxide) in the altered country rock. It is all invisible, occurring most plentifully in bunches of glistening black limonite in the quartz, much of the gold dollied out of the stone being coated with iron oxides. It has also been found that near where the gold is richest is a thin band (up to one foot in thickness) of hard "casing," beyond which the country rock is quite soft and decomposed. As already mentioned, the gold leaves a leader wherever it branches or is intersected by another.

Three auriferous shoots, all pitching steeply south-westwards, have so far been followed between the shafts. In that nearest the whip shaft two feet six inches stone yielded 2½ oz. per ton for a few feet. West of the whip shaft the reef, part of which is pyritous, becomes very poor, 12 to 18 inches of stone being left standing for that reason, though adjacent thin leaders carry comparatively good gold. Again, six feet east of the prospecting shaft, the main leader pinches down to one inch, and there the country rock is quite unsoftened.

Output.—The following crushings were made at Hart's battery, on Thane's Creek:—

7 Dec., 1903	.. 9½	tons crushed for	9 oz. 14 dwt. 1 gr.	= 1 oz. per ton
7 Mar., 1904	... 12	,, ,,	17 oz. 10 dwt. 6 gr.	= 1 oz. 9 dwt. per ton
27 June, 1904	... 8	,, ,,	19 oz. 18 dwt, 15 gr.	= 2 oz. 10 dwt. per ton
13 Feb., 1905	... 15½	,, ,,	39 oz. 4 dwt. 6 gr.	= 2 oz. 10 dwt. per ton
	45	,, ,,	86 oz. 8 dwt. 4 gr.	= 1 oz. 18½ dwt. per ton

Conclusions.—An inspection of the Golden Gate deposit forces on one's attention the great similarity between it and the Monte Christo in its irregular leaders and zone of altered country rock.

The amount of work done during the last three years is very disappointing, the time having been apparently spent in tracing each leader till the gold left it. To make the shafts and drives approximately 270 tons must have been broken down, and, adding 25 per cent. for stopings, the total quantity raised amounts to 350 tons for 86 oz. of gold, which is equal to 5 dwt. per ton. It would, therefore, at first sight, seem improbable that the reef would pay to work by any method involving the blocking out and breaking down of the whole reef, but it must be remembered that the yield would in all likelihood be considerably increased if the whole of the stone were put through. Further development is by this consideration rendered justifiable.

BIG HILL.*

The present holders have since my last visit opened a drive for 170 feet along the Victoria reef from the old workings to the main adit, and have sunk a 20-feet winze on the same reef, about 70 feet along the drive. The reef has not been broken down, but one or two drill holes were made in it, proving two feet of stone, and the drillings are said to have yielded ½-oz. prospects.

The Big Hill mill now comprises a 16-horsepower portable boiler, a Blake stonebreaker (twelve tons per hour capacity), a Thompson crusher (two tons an hour), and a Wilfley table (one ton an hour). The Thompson crusher has proved a failure, because of so many of the working parts being exposed to the intense cutting action of the sands produced; two-inch manganese steel pins carrying the rollers wear out within a week, as do also one-inch manganese steel carriers (tires).

It is rumoured that a new company has lately been floated in London.

AUSTRALIAN.*

This reef was discovered by Martindale, whose crushings from 1899 to 1903 amounted to—

184 tons for a yield of 325 oz. 14 dwt. 15 gr. = 1 oz. 15½ dwt. per ton.

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* See G.S.Q.P. No. 186.

Soon after Martindale's retirement from the claim it was abandoned, because of local impoverishment. It has now (in August, 1905) just been taken up again in a five-acre lease, and there is promise of its being worked on a more extensive scale than heretofore.

SAINT PATRICK.*

The *P.C.*—The St. Patrick is now an extended claim of 400 feet by 400 feet.

The intention of the claimholders to continue the sinking of the No. 5 shaft (Sutton's, 120 feet vertical), to cut the reef at 200 feet depth, has been hitherto frustrated by the serious illness of the manager (Mr. John Clare). Mr. Clare bases his belief in the future of the reef on the fact that a solid body of auriferous pyrite and quartz was coming in at the bottom of the main underlie (No. 4 shaft), when it had to be abandoned because of the large amount (500 gallons) of water met with. Mr. Clare's knowledge of the following crushings from the western end of the reef fortifies him in his faith :—

700 tons for 1 oz. 14 dwt. per ton during 1894-1898,
240 tons for 18 dwt. per ton during 1901-1903.

No. 1 West.—A shaft has been sunk 30 feet, and a drive opened for 30 feet to the south. This drive probably passed over the cap of the reef (pitching westwards), for it was first proved in a gully ½ chain to the east.

No. 1 North.—Since my last visit in 1903 a fourth shaft has been sunk, cutting the "North" reef at a depth of 55 feet. This was continued for 14 feet along the reef on nine inches of stone carrying 15 dwt. per ton. Further prospecting has been abandoned on it for the present, because the workings are almost at the boundary of the P.C., into which the reef dips.

GLADSTONE.*

During the last two years Mr. Kerridge has been receiving Government assistance in proving the Gladstone reef below the old workings. He has struck the reef at 120 feet depth, and reports it payable, but is unable to work it because of lack of capital. The mine has now (August, 1905) been idle for some weeks. Mr. Kerridge has given me the following particulars :—

The main vertical shaft is now 126 feet deep, and there is a 26-foot crosscut to the reef at a depth of 120 feet, with drives twelve feet east and three or four feet west on the reef.

The reef is from six inches to twelve inches thick. A crushing in the small three-head battery at the mine gave—

2 tons for 19 dwt. per ton ;

but it is considered that half the gold contents were lost in treatment. The reef cut was believed to be only a branch from the main one, because of a split taking place on the bottom level in the underlie.

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* See G.S.Q.P. No. 186.

The continual pumping in the main vertical shaft drained the old workings, and before ceasing operations Mr. Kerridge continued the underlie whip shaft to 80 feet depth, and drove 37 feet east, striking good gold near a crosscourse. Several crushings were obtained, which were not altogether satisfactory because of the difficulty in effecting amalgamation.

GUIDING STAR.

LOCATION.

The Guiding Star reef crosses the main road within 30 chains of Thane's Creek, about 6½ miles west of Pratten. The eastern workings are now included in Costello's selection, the remainder being on the goldfield.

HISTORY.

Gold was first found in loose fragments of quartz in the soil about 1879 or 1880. Payable stone was from the first raised from the No. 1 West; while that in the P.C. was poor, and no other claims seem to have done any work to speak of at the time of the first rush. About 1895 two other shoots of gold were located to the west on the same reef. A shaft has also been sunk some chains to the east of the P.C., but without finding the reef. The whole line is now again deserted. None of the shafts are accessible, and, of course, little as to the nature of the reef can be seen at the surface.

COUNTRY.

The footwall is strongly defined, the country rock below water-level being a dark blue-black, shaly slate, which on the surface weathers light-brown, often with a light-blue interior. No stratification can be made out on the outcrop, though faces which may be joints or even laminations run north-westwards.

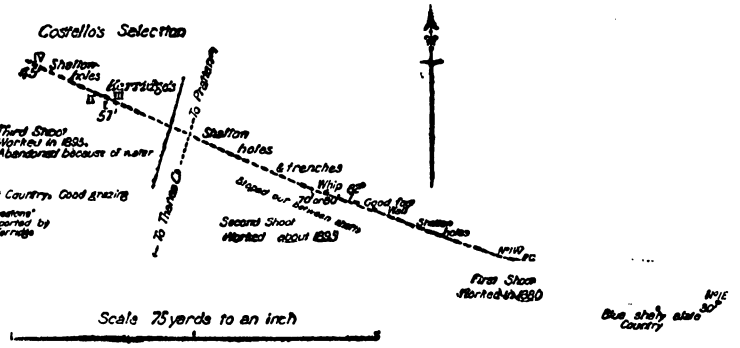

Costello's Selection
45°
Shallow holes
Kerridge's
II
I
III
51'
"Third Shoot" Worked in 1893. Abandoned because of water
Flat Country. Good grazing
"Limestone" reported by Kerridge
To Pratten
To Thane's C.
Shallow holes
& trenches
Whip
Stoped out 70 or 80 between them
Good Pay
Second Shoot Worked about 1893
Shallow holes
No 1 W
PC
First Shoot Worked in 1880
No 1 E
30°
Blue shaly slate Country
Scale 75 yards to an inch

FIG. 2.—SKETCH PLAN OF WORKINGS ON GUIDING STAR.

REEF.

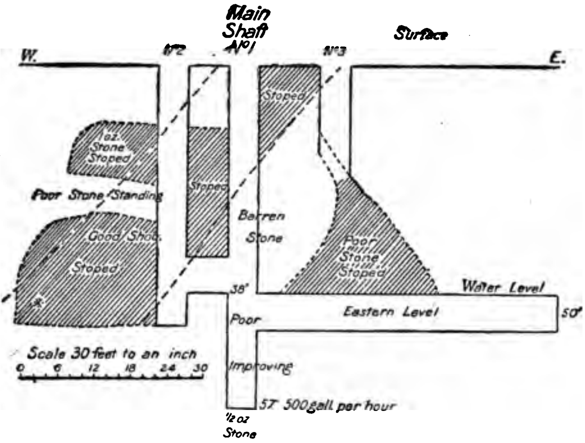
The reef, which has been worked over a distance of ten chains, has a general course of west 20 degrees north, its dip at the surface being 82 degrees to the north 20 degrees east, but it is more nearly vertical at a depth.

First Shoot.—In the No. 1 West (on which claim the discovery was made) the reef averaged 15 inches, and to a depth of 80 feet (10 feet below the water-level) it carried from 10 to 30 dwt. (averaging slightly under an ounce) per ton. The shoot pitched westwards.

In the P.C. shaft, ten feet east of the No. 1 West, the reef widened (to 18 inches at the surface, and to three feet at 36 feet depth), and at the same time the gold contents fell to 3 dwt. per ton, as proved in an eight-ton trial crushing. This shaft is on a slight bend towards the east, which is probably local, the continuation being in all likelihood towards the east-south-east. Owing to this bend, the quartz on the eastern end of the shaft is cracked and internally slickensided; elsewhere it is massive and irregularly laminated by blue seams, indicating it to be partly a replacement reef.

Second Shoot.—This lies about three chains west-north-west of the P.C. Four shafts—the deepest about 70 feet—have been sunk here, and the ground between them has been stoped out over a distance of a chain.

Third Shoot.—This is situated five chains beyond the second. Mr. Kerridge, who did most of the work on this shoot, has given me the accompanying section (Fig. 3), showing the extent of the stopes between his shafts Nos. 2 and 3. The main shaft is 57 feet deep, the water-level being at 38 feet depth. Mr. Kerridge reports that 20 inches of 1-oz. stone still remains on the 50-foot level in No. 2 shaft, and that the stone in the shaft, continuously improving, runs ½ oz. per ton in the bottom.



* 20-inch hard reef, with plumbago dig, and strong clean walls.

FIG. 3.—KERRIDGE'S WORKINGS ON GUIDING STAR.

Somewhat over 100 tons has been crushed, the last return being for 1 oz. per ton. It will be noticed that the shoot here also pitches westwards. It is understood that the mine was abandoned because of the water encountered (500 gallons per hour).

CONCLUSION.

The above information may be of use to anyone disposed to open up the reef and try it below water-level. With regard to the continuation of the reef eastwards from the P.C., I was informed by Mr. J. Clare, a miner experienced in these fields, and to whom I am indebted for much of the above information, that in prospecting for reefs he has generally found it safe to follow the direction of the overlooking. ridge or spur. This agrees with the present trend of geological opinion. It has been shown that in the region north of the Yellowstone Park, in Montana, there is considerable agreement between faults and drainage lines* (and in consequence watersheds).

Mr. Clare spoke of a 2-foot barren reef about a quarter of a mile east of the Gladstone, and possibly a continuation of it, but there was not time for me to see it.

CULLAN'S TWINS.

This is a prospecting area (200 feet by 200 feet) located in a dense scrub on the Thane's Creek Goldfield, 4½ miles west of Thane, the present terminus of the Warwick-Goondiwindi Railway, and 24 miles from Warwick.

The whole of this country has been thoroughly prospected for alluvial, but, owing to its hitherto isolated position, little or no work has been done on the reefs, outcrops of which are reported every few chains to the south of Cullan's.

The discovery of auriferous quartz here was made in March, 1904, through numerous fragments of the stone having been brought to the surface of the soil by the roots of a gum-tree. Trenching in the neighbourhood has resulted in the discovery of three lines of reef.

NORTHERN REEF.

Reef.—The northern reef strikes west ten degrees north, and dips 86 degrees to south ten degrees west. It is massive and well defined; the footwall is slickensided, but the hanging-wall, though easily detached from the quartz, does not show signs of movement. The thickness of the reef varies between nine inches (near the surface) and two feet (in the lower workings), the changes being gradual.

The stone is bluish in colour, and has a glassy appearance; towards the hanging-wall it is to some extent laminated by thin inclusions of the country rock. Galena is said to have been seen in it, as also copper stains, of which, however, I saw none. The gold occurs mostly on yellow "faces" or joints in the quartz, which appear to have been lined with pyrite, deposited since the quartz. It is nearly all found within six inches of the hanging-wall, the quartz on the footwall being generally considered barren. No absolutely blank part of the reef has yet been found.

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* A Fracture Valley System. Joseph P. Iddings, in Jour. of Geol., V. XIII., 1904.

The gold contents of the reef appear to have been favourably influenced by intersecting or branching leaders (without gold), which glance off to the east-north-east in the footwall, and to the west-south-west in the hanging-wall, as though following a set of parallel fractures. One exception to this rule is to be seen on the 15-foot level, where, at ten feet east of the shaft, the normal twelve-inch reef has increased to 20 inches. Just beyond that point a "horse" comes in, causing the splitting up of the reef into a number of barren leaders, which branch off into the footwall, the main part, six inches thick, continuing on the line of the reef. The reef at this point is not rich.

The country rock is a shaly slate, dipping about 45 degrees to the west 20 degrees south.

Workings.—The main shaft is 50 feet deep. At the bottom a level runs 20 feet to the west, and above it the reef has been, and is being, stoped to within ten feet of the surface on a main shoot pitching westwards, and reaching the surface for some yards west of the shaft. In the bottom level the reef—18 inches wide in the shaft—widens to two feet, but again contracts in the face to twelve inches. A small shoot, two feet in length, is known to occur in the sump. In the western drive on the 15-foot level the reef is only nine inches thick, and can be seen to be pinching upwards; in the eastern drive it opens up to 20 inches at ten feet from the shaft, where, as already explained, a number of leaders branch off, and the main reef is reduced to six inches in thickness.

Output (per Mr. Cullan)—

32½ tons for 31 oz. 16 dwt. = 19 dwt. 13 gr. per ton
48 ,, 38 oz. 16 dwt. = 16 dwt. 4 gr. per ton
20 ,, = 6 dwt. per ton.

This last crushing was a trial from all along the bottom, and the return is far too small to pay under the present conditions of working—*i.e.*, with one man below and one man on the brace.

Results.—In spite of the local impoverishment in the 50-foot level, the reef is well worthy of a thorough trial by continuation of the shaft to greater depths, but, unfortunately, the present holders have not sufficient resources to undertake this expense. The work done, though inconsiderable, is sufficient to illustrate the permanency and promise of the reef.

MIDDLE REEF.

Reef.—The middle reef lies 35 yards south of the northern, to which it is parallel. The outcrop exposed in a trench is from two feet to two feet six inches wide.

Stone.—The quartz is bluish and glassy in appearance, the gold being contained in nine inches of its thickness. The richest stone was found at a small bend and break in the reef. The gold has been traced on the surface over a distance of 100 yards.

Workings.—The workings (now flooded) comprise two 14-foot shafts within a few feet of one another, and lying south 30 degrees east of the main shaft on the northern reef, and two trenches, three or four yards in length.

Output.—A trial crushing, from the whole width of the reef exposed in the trenches, of—

24 tons yielded 4½ dwt. per ton.

This is too small to pay expenses (with cartage 6s., and battery treatment 11s. 6d. per ton). Several tons of stone from the shafts now lie at grass.

SOUTHERN REEF.

Reef.—The workings on this reef lie 67 yards south 14 degrees east of those on the middle reef. The reef runs west 22 degrees north, and is practically vertical. Where now exposed, it is about six inches thick. It appears to be pinching towards the west, and may have been thicker in the stoped portion. It is well defined, being on a strong fissure, the hanging-wall having slickensides and corrugations inclined 45 degrees to the west. The main shoot of gold worked for about 35 feet from the surface was found to follow one of these corrugations, as well as a cross leader dipping about 45 degrees to the north-west.

The country rock adjacent to the stopes is sandy, but the same blue slate as near the northern reef is found west of the stopes.

Workings.—The workings comprise two shafts 20 feet apart, the eastern 25 feet, and the western 35 feet, deep. The reef has been stoped out between them and for a few feet on each side, but in the faces and floor is believed to be too poor to exploit.

The reef is worthy of further prospecting by sinking.

Output.—A few tons only have been taken from here, and they are included in the crushings given above.

Brisbane, 4th September, 1905.

By Authority: GEORGE ARTHUR VAUGHAN, Government Printer, William street, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.
(B. Dunstan, Acting Government Geologist.)
PUBLICATION No. 204.

E WEST MORETON (IPSWICH) COALFIELD

SECOND REPORT ON.

Vith Special Reference to the Bundamba District.)

WITH 2 MAPS, 1 PLATE, AND 8 FIGURES.

BY

WALTER E. CAMERON, B.A. (Cantab.),
ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
THORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1907.

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Queensland.

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(B. Dunstan, Acting Government Geologist.)

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THE WEST MORETON (IPSWICH) COALFIELD

SECOND REPORT ON.

(With Special Reference to the Bundamba District.)

WITH 2 MAPS, 1 PLATE, AND 8 FIGURES.

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THE WEST MORETON (IPSWICH) COALFIELD

WITH SPECIAL REFERENCE TO THE BUNDAMBA DISTRICT.

SECOND REPORT.

Chapter I.—General.

I.—INTRODUCTION: PRODUCTION AND PROSPECTS.

The West Moreton Coalfield is at present the chief producing coalfield of the State, its importance being due, in the first place, to the generally useful character of its coal for ordinary commercial purposes, such as marine and land steaming, coke-making, blacksmithing, and gas-making; and, in the second place, to the proximity of the field to the chief industrial centre and most important shipping port of the State. This latter circumstance will always be an important and favourable factor in the future prosperity of the field, as it will command an easily accessible and constantly growing market, where less favourably situated fields can only compete under the disadvantages of higher freight charges for transport from the mine.

During the last five years the Ipswich Field has turned out more than 75 per cent. of the total coal production of Queensland; its average annual output for that period having been a little under 400,000 tons. This represents a value to the Ipswich district annually of about £120,000.

The diagram shown in Fig. 1 gives a graphic representation of the important part played by the Ipswich and Darling Downs fields combined in the total output of the State during the last twenty years. As the returns from these two districts have not been kept separate, it is not possible to show those from the Ipswich Field alone; but, as the figures for the former district constitute only about 5 per cent. of the total of the two combined, the diagram would not be materially altered by their exclusion.

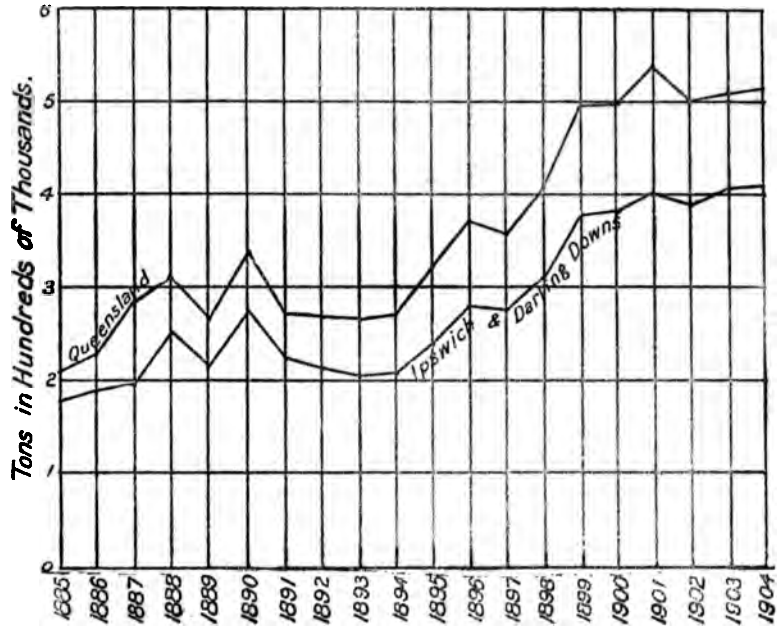

FIG. 1.—PRODUCTION OF QUEENSLAND COAL DURING TWENTY YEARS ENDED 1904.

As shown by the diagram and Table I., the annual output of coal from Queensland mines increased during the years 1894 to 1899 from 270,705 tons to 494,000 tons, or by over 80 per cent.; while for the succeeding five years the increase of output did not amount to 4 per cent. This sudden check to expansion was no doubt primarily due to the disastrous drought, the effects of which have paralysed Queensland trade generally during the last five years; and, as a natural consequence, greatly curtailed the coal consumption of the State. The rapid increase of demand shown by the former five-year period led to the opening up of a number of new collieries, especially along the southern extension of the outcrop of the Aberdare seam, during the latter five-year period; while the increase of competition thus brought about was not met by any corresponding increase in the demand for coal. The consequence has been a glut of the market, so that at the present time the output necessary to keep the mines now opened up in full work is in excess of the demand. As a consequence, nearly all the pits are periodically idle.

Efforts have been made to meet this expanding production by working up an export trade to foreign countries; but, so far, without much success. The coal is of a brittle character, and, with the exposure to weather and rough treatment inseparable from such a trade, becomes quickly converted into slack. It consequently cannot be expected to compete with the durable coals of the Newcastle district, which are even more favourably situated as regards shipping facilities for such a trade.

TABLE I.—SHOWING PRODUCTION OF QUEENSLAND COAL FOR 20 YEARS ENDING 31ST DECEMBER, 1904.

Year.	Queensland.	Value.	West Moreton and Darling Downs Coalfields.	Value.
	Tons.	£	Tons.	£
1885	209,698	87,228	180,744	71,258
1886	228,656	95,243	189,608	72,054
1887	283,813	97,460	193,286	71,851
1888	311,412	127,947	254,778	98,851
1889	265,507	121,118	217,240	195,202
1890	338,344	157,077	276,063	120,476
1891	271,603	128,198	222,766	97,757
1892	265,086	123,308	215,535	91,798
1893	264.403	125,340	204,429	86,582
1894	270,705	114,593	207,672	81,201
1895	323,068	132,530	239,712	89,150
1896	371,390	154,987	280,094	106,740
1897	358,407	139,889	277,172	97,411
1898	407,934	150,493	310,444	103,927
1899	494,009	175,715	373,655	127,305
1900	497,132	173,705	379,504	126,425
1901	539,472	189,877	420,500	139,860
1902	501,531	172,286	390,603	127,851
1903	507,801	164,798	403,462	124,479
1904	512.015	166,536	408,186	124,339

Table II., the figures for which were kindly supplied to me by the Commissioner for Railways, shows the amount of coal railed from the Ipswich district for consumption in various industries in Brisbane. It shows that the Ipswich district depends most of all for its market on the employment of the coal for marine steaming purposes by steamers calling at the port of Brisbane. Beside the amount shown in the table, about 20,000 tons are annually despatched by river from the North Ipswich district for bunker purposes, so that the demand for this purpose is seen to have fluctuated during the last five years between 140,000 and 170,000 tons annually. Probably another 30,000 tons is despatched from the North Ipswich district for various markets or in the form of coke, but the exact figures are not to hand.

TABLE II.—SHOWING CONSUMPTION IN VARIOUS INDUSTRIES OF COAL RAILED FROM THE IPSWICH DISTRICT FOR FIVE YEARS ENDING 1904.

(Figures supplied by the Commissioner for Railways.)

Year.	Railway Purposes.	Bunker.	Cargo.	Gas and Meat Works.	Totals.
	Tons.	Tons.	Tons.	Tons.	Tons.
1900	46,349	122,073	40,301	19,168	227,891
1901	50,173	147,025	42,068	9,282	248,548
1902	47,604	130,197	31,976	8,652	218,429
1903	48,006	127,011	60,034	7,502	242,553
1904	56,775	121,765	76,017	7,036	261,593

The establishment of smelting works to treat the iron ores of the Queensland coast seems to be the only industry that would be likely to give any prospect of a rapid expansion in the consumption of Ipswich coal. Several of the seams make first-rate coke, and the mines would be as conveniently situated as any others in Queensland for economical treatment of these ores. The metallurgical industries are the most lavish consumers of coal of any, and until some such industries are established in Southern Queensland no serious taxing of the coal resources of the Ipswich district need be feared. With the revival of trade consequent on better seasons, and the natural increase of shipping to be expected from a port like Brisbane, the demand for coal from the Ipswich district may be expected to gradually increase, and the present slackness of the trade disappear, while the low prices that may be looked for henceforth will probably prevent the opening up of new ventures, such as have caused a plethora of coal during the last five years.

II. LOCALITIES WORKED FOR COAL.

The majority of the mines are in two main districts. The most productive—the Bundamba district—supplies over three-fourths of the coal turned out from the field, and covers an area of about 12 square miles, lying mainly to the south of the Brisbane-to-Ipswich railway line, between Six-mile and Bundamba Creeks, and from three to eight miles east of Ipswich. It affords the main steaming coals loaded into bunkers at Brisbane and used by the Railway Department for locomotive purposes. The second important district lies to the north of the Bremer River, immediately north of the town of Ipswich, and has been worked over an area about three miles in length by one mile in breadth. Its seams furnish the whole of the coke manufactured on the field, but there are also some good steam, blacksmithing, and gas coals. Besides these two main districts, there are the more distant localities of Walloon, Rosewood, and Purga, lying to the west and south of Ipswich, and furnishing a coal of a distinct character. It is much richer in volatile hydrocarbons, and gives a much larger percentage of gas in the gasworks retorts, where it is chiefly consumed. Detailed mapping of the field has shown that these seams occur in much higher beds of the coal series than those containing the coals of North Ipswich and Bundamba, these beds having been brought down into their present position about Walloon and Purga by a folding over of the lower beds along an axis striking north-westerly across the field through the town of Ipswich.

III. TRANSPORT FACILITIES.

Most of the coal from the North Ipswich district comes down the Bremer and Brisbane Rivers in punts, the distance to the wharves in Brisbane being about 35 miles, and to deep water at Pinkenba about

45 miles. The coke is removed by the North Ipswich branch line through Ipswich to Brisbane, a distance of about 26 miles to the wharves.

The Bundamba district is served by several branch lines and short spurs from the main line. Of these the latest one finished goes south from Redbank Station, 15 miles from the wharves, and reaches the furthest point of the field in another seven miles. It loops on at this point with the old Swanbank line, starting south from Bundamba, 20 miles from the wharves, and tapping the western and southern portion of the district. The more remote mines at Walloon and Rosewood are situated near the main line to Toowoomba, distant 30 miles and 36 miles respectively from Brisbane; while that at Purga, on the branch line from Ipswich to Dugandan, is situate about 29 miles from the port.

IV. MAPPING OF THE FIELD.

1. General Map of the Coalfield.

The Ipswich Coalfield was first geologically mapped and reported on by the author in 1899. Map No. 2, accompanying that report, was on a scale of 20 chains to an inch, and embraced all the coal mines then working, except those at Purga and Walloon. In the North Ipswich district the outcrops of six seams (all of which had been worked to some extent) and of their accompanying beds of sandstone and shale were mapped in detail over an area some three miles in length along the outcrops of the seams on the northern side of the Bremer River by about a mile in breadth. In the Bundamba district the outcrops of seven known seams and their accompanying beds were shown as far as they could be traced over an area of about twelve square miles between Bundamba and Six-mile Creeks. These two districts are separated by a large area of basalt country between Bundamba Creek and Ipswich, and by the alluvial deposits along the bends of the Bremer River, and the relations between the two areas are thus obscured. Recent more particular study, however, has furnished a theory of their connection with each other, which shows a great probability of being approximately correct, and which has important economic bearings. This connection is shown on the general map of the field accompanying this report. The map is on a scale of one mile to an inch, and gives a clearer idea of the geological structure of the field and the connection between the different areas than the older map. On it is shown the probable trend of the outcrop of the highest seam of the Bundamba district (the Aberdare Seam) under the basalt and alluvium referred to above. Above this seam in the Bundamba district, and stretching round the southern edge of the basalt towards the south of Ipswich, is a great thickness of sandstones, which have not yet given signs of being coal-bearing, and which I have named the "Bundamba Grits," or unproductive series. The base of this unproductive series crosses the outskirts of the town of Ipswich to the south of Denmark Hill, the fossiliferous shales and coals occupying the summit of that hill being apparently on the same horizon as the Aberdare Seam, while the underlying Four-foot Sandstone apparently crosses the northern slope of the hill where it is quarried at several points for gravel. The Cooneana Sandstone of the Bundamba district immediately underlying the lower seams of that district is apparently identical with a sandstone which stretches across the western portion of Ipswich from the quarries at the end of Harlin road past the back of the Grammar School, and is found again overlying the North Ipswich seams about Tivoli.

If this theory as to the position of the various beds be correct, it must follow that the coals of the North Ipswich district are on a lower horizon than those at Bundamba, being represented in their higher members by the coals and shales underlying the Cooneana Sandstone, which are the lowest beds exposed in the Bundamba district. They may, therefore, be expected to be found over a wide area in the centre of the latter district at no great distance from the surface.

The present mapping thus shows a lower productive series of beds, containing the coal seams of the North Ipswich and Bundamba districts, overlain further south by an unproductive series of sandy rocks, the highest members of which are not seen. These latter beds bound the extension of the former on the south from Goodna to Ipswich, thus limiting the area over which mining on these coals may be expected to extend in this direction. To the west of Ipswich these unproductive beds—and with them, of course, the underlying coal-bearing beds—are sharply bent over to the south-west over a north-westerly striking axis of folding, by which a still higher series of coal-bearing beds is brought in. These beds were first worked for coal at Walloon, and may be known as the "Walloon Beds," or upper productive series. They are also worked to some small extent at Rosewood and Purga, and apparently occupy the whole of the area of the map south-west of a line drawn from Yahmahnto, on the Fassifern line, to Borallon, on the Brisbane Valley line. They afford few exposures, consisting mainly of soft sandstone and clay shales, which have weathered to a generally level surface. The coals contained in them are quite distinct in character from those worked in the lower productive series about Ipswich and Bundamba, having a much greater content of volatile hydrocarbon and a different physical structure.

2. MAP OF THE BUNDAMBA DISTRICT.

In the North Ipswich district there has been little fresh development of importance since the writer's previous report. The production for 1904 was about 54,182 tons, as against 46,743 tons during 1898, these figures representing a drop from 16 per cent. of the total in the former year to 14 per cent. in the latter year. The number of producing mines dropped from eight to five. In the Bundamba district, however, the opening up of a number of new pits to the south and east of the old established mines around Blackstone, Bundamba, and Dinmore led to a request for a more complete map of this district, which would show the relations of the seams opened out in these mines to the earlier worked and better known coals. Accordingly, this district was mapped again on a larger scale (viz., 10 chains to an inch), and the map has been extended to take in the whole of the area over which the productive series of the coal measures occur between Six-mile and Bundamba Creeks, these beds being covered to the east, south, and west by the overlying and unproductive Bundamba Grits.

In this map the positions of the main workings and their general trend is shown by shading. The workings thus shown have no pretensions to accuracy of detail, as it would have involved a much greater expenditure of time than seemed justified by the benefits to be gained to have brought all the workings up to date and accurately plotted them on the map. The detail shown is intended merely to indicate generally what areas have been worked to the greatest extent, and to bring out more clearly the trend of these seams across the field.

The topography of the district has been derived from various sources, and accuracy in detail is not here claimed. It is unfortunate that the Geological Survey has no officer on the staff who could be engaged solely in making topographical maps of important mineral areas, and the Ipswich Coalfield is a mineral area that deserves early attention in this respect. A topographical map of the field, properly contoured, and with surface features accurately delineated, would not only be of the utmost value to the geologist and prospector as an aid in locating and tracing seams, but would also be of service to every mine manager and proprietor interested in the coal-mining industry. The accompanying map gives as much of detail as could be gathered in the time that I found justified in expending on the work. The greater portion of the topography was compiled from maps and original survey plans in the Lands Office, but the Railway Survey Department also kindly lent important aid with details of railway and feature surveys of certain portions.

The detailed mapping of this district has, I think, allowed of a correct representation of the relation between the seams around Dinmore and New Chum with those of the rest of the field. This relation has hitherto been obscure. It will be explained later on in this report. The drawing in of the outcrops of the various seams over many areas as yet untouched should, I think, prove of some considerable assistance in future prospecting along these outcrops. The mapping has also served to show the limits of the area over which the coals of the Bundamba district can be expected to be found at workable depths, this area being limited to the east, south, and west by the depth to which the coals can be worked under the overlying unproductive Bundamba Grits.

V. GENERAL GEOLOGY OF THE TRIAS-JURA SYSTEM OF SOUTHERN QUEENSLAND.

AGE AND EXTENT OF THE BEDS.

The beds of the Ipswich Coalfield have furnished some seventy species of plants belonging to the natural orders Calamariæ, Filiciæ, Cycadaceæ, and Coniferæ, by which they have been determined to be of triasso-jurassic age. They have also furnished one genus each of Crustacea, Insecta, and Lamellibranchiata.

Beds of similar lithological character, and furnishing here and there examples of the same flora, are met with over an area of about 30,000 square miles in the Moreton, Wide Bay, Burnett, and Darling Downs districts and in the southern portion of the Leichhardt district. An extensive area of these rocks stretches as a belt some 40 miles in width in the form of a crescent running from the heads of the Richmond and Clarence Rivers, in New South Wales, for a distance of some 300 miles in a north-westerly direction to the head of the Dawson Valley, in the Leichhardt district. Besides the mines of the Ipswich Coalfield, this belt contains numerous other seams of coal, which have been worked to some extent in the Walloon-Rosewood districts, and in several places on the Darling Downs, west of the Main Dividing Range.

South of the city of Brisbane this extensive belt is connected by a narrow neck of the same rocks with a second long strip which extends for about 300 miles along the coast from a little south of Brisbane to a little north of Bundaberg. The maximum width of this belt is about 40 miles. The coalmines of the Burrum Field lie in this coastal belt of the Trias-Jura. At Point Arkwright this belt is shown on the Geological Map of the colony to be broken by a tongue of older Palæozoic rocks, but in a paper read before the Linnean Society of New South Wales, entitled "The Geology of the Volcanic Area of the East Moreton and Wide Bay Districts," Mr. H. I. Jensen has recently stated that "there is no break between the Ipswich and Burrum Coal Measures, as the Geological Map of Queensland leads one to suppose."

Mr. Jack included all the beds north of Point Arkwright in his "Burrum Formation," the rocks south of that point and in the inland belt of Trias-Jura being included in a later "Ipswich Formation."

The Burrum Formation has as yet furnished only some ten or eleven species of plants, of which four occur in the Ipswich Beds, while all the genera are represented by allied species in the Upper Beds. In addition, two genera of lamellibranchs from the Burrum Beds have not as yet been found in the Ipswich Beds. In view of the distance between the places where these two formations have been mainly studied, and the paucity of the flora as yet found in the Burrum Beds, there does not seem to have been sufficient evidence for a separation of the Trias-Jura into two formations; and, in any case, the evidence for considering the Burrum Beds as belonging to an earlier period of the Trias-Jura is not conclusive. The two formations have long been considered as identical in age by the Geological Survey, and the recent observations of Mr. Jensen lends confirmation to that conclusion.

GENERAL DISPOSITION OF THE TRIAS-JURA BEDS.

The Trias-Jura Beds along the coast between Brisbane and Bundaberg, and the larger inland belt in which the Ipswich and Darling Downs Coalfields lie, were laid down on a floor of highly-folded Palæozoic rocks, which have been intruded by plutonic rocks, mainly of a granitic type. These older rocks have subsequently been exposed over a wide area between the two belts of Trias-Jura by a gentle bending up of the earth's crust since their deposition. This area of bending runs, roughly, in a north-westerly direction from a few miles west of Brisbane. Subsequent denudation of the coastwise fall of the anticline thus formed has denuded off wide areas of Trias-Jura along the upper waters of the Burnett, Mary, and other coastal rivers. Numerous small isolated areas of Trias-Jura Beds are still found scattered along the crest of the broad anticline with varying gentle inclinations from the horizontal. These isolated areas have escaped the general denudation, and still give evidence of the once continuous occurrence of the Trias-Jura over the whole area.

As a consequence of this bending up of the Trias-Jura the beds of the coastal belt have a general east to north-east dip under the sea, while those of the inland belt have a general south-westerly to west-south-westerly dip under the overlying Cretaceous rocks of the Artesian Water System of the interior. The Cretaceous rocks succeed those of the Trias-Jura without any observable break or stratigraphical unconformity, but with a complete change from the terrestrial and estuarine flora of the latter to a fauna of marine mollusca and allied genera. The bending up of the Trias-Jura Beds becomes inappreciable in amount to the south of the Brisbane River, with the effect that these beds can here be traced right across the axis of the fold, thus forming the strip of Trias-Jura country south of Brisbane, which joins up the inland and coastal belts described above.

THE NORTHERN BOUNDARY OF THE IPSWICH COALFIELD.

The coal beds of the Ipswich Field are amongst the lowest of the Trias-Jura system exposed by the gentle bending of the strata above described, and by the denudation to which they have been subjected along the Brisbane and Bremer Valleys. They lie close to the junction with the Palæozoic rocks, along the crest of the broad anticline above described. The junction between the two systems here runs roughly east and west, and has been mapped in detail for some 30 miles along the course of the Brisbane River. Along this junction a series of coarse conglomerates interbedded with some thin sandstones, and occasionally with thin layers of coal, has been exposed by a puckering up of the Trias-Jura Beds in the bending process above referred to and by the denudation of the overlying coal-bearing beds lying further to the south.

These conglomerates dip roughly to the south-east, and no doubt represent the basal beds of the Trias-Jura System. Along their northern boundary on the Brisbane River they abut against an irregular wall of the older Palæozoic rocks, and are no doubt the results of the destruction of an old coast of those rocks by an advancing sea or lake, in which the higher coal measure rocks were subsequently laid down. In the former report on the Ipswich Coalfield, this junction along the Brisbane River was assumed to be a faulted one, but on further consideration I am led to the opinon that it is merely an unconformable junction representing an old cliff face of the Trias-Jura period.

The relations between the two systems have been clearly exposed by the course of the Brisbane River, which has carved out its winding valley along the junction over a distance of some 30 miles. The area over which the conglomerates are exposed extends for a distance of about 10 miles along the junction, and is shown on the accompanying general map of the coalfield.

THE IPSWICH BEDS.

Overlying the basal conglomerate of the Trias-Jura System, and covering an area of about 50 square miles to the north and south of the Western railway line, between the towns of Goodna and Ipswich, are the coal measures proper of the North Ipswich and Bundamba mining districts. I have restricted the name "Ipswich Beds" to this stage of the Trias-Jura System, because it was these beds that were first worked and studied, and because it has become possible by recent study to distinguish them from the later coal measures of the same system which have been worked about Walloon.

The Ipswich Beds probably represent a thickness of some 2,500 ft. of sandstones and shales, with fourteen or fifteen interbedded coals, that have been worked at one time or another in the two districts abovenamed. These beds have been thrown into long gentle folds, with general maximum inclinations from the horizontal of about 15°. The area over which they have been exposed lies nearly on the crest of the Trias-Jura anticline, and the puckering up of the beds into the gentle folds just described has apparently been a minor effect of the general folding about the axis of that anticline. The subsequent planing down of the crests of these folds by surface denudation has exposed the outcrops of the seams, which it has thus been possible to trace in detail over a great portion of the coalfield.

South of the area of the coalfield the folding across the Trias-Jura anticline appears to decrease in amount, and the Ipswich Beds sink under the next succeeding stage of the Trias-Jura, which I have named the Bundamba Beds.

THE BUNDAMBA BEDS.

The Bundamba Beds succeed the Ipswich Beds conformably, and occupy the greater part of the south-eastern corner of the general map of the coalfield. The have, so far, proved unproductive, except for a small seam of about 1 ft. 6in. near their base, which was formerly worked from the West Moreton shaft, south of Blackstone, and was known as the West Moreton Seam. Their base may conveniently be considered as lying about 70 ft. above the top seam (the Aberdare Seam) of the Ipswich Beds, and forms a generally easily recognised horizon of coarse grits and conglomerate, by means of which it has been possible to draw in the position of the outcrop of that seam throughout the field. The base of the Bundamba Grits, which thus gives a pretty good indication of the limits of the area over which the coals of the Ipswich Beds may be expected to be within workable distances of the surface, has not been traced further east than Goodna. Beyond that town it is overlain by more recent beds, possibly of Cretaceous Age, from which a rich flora of Dicotyledonous plants has been obtained. The Bundamba Beds consist of coarse grits and sandstones with thin interbedded finer strata.

MONOCLINAL FOLDING OF THE IPSWICH AND BUNDAMBA BEDS AND THEIR JUNCTION WITH THE WALLOON BEDS.

West of the town of Ipswich the lower series of the Trias-Jura just described have been sharply bent over an axis striking north-north-west and south-south-east, and disappear to the west under the softer sandstone shales and clays of the Walloon series. The Walloon Beds lie with only slight deviations from the horizontal, and cover a wide area in the Walloon, Rosewood, and Dugandan districts, where they have been worked for coal at several points. The upturned edges of the Bundamba Grits and Ipswich Coal Beds can be followed over a width of about a mile, and have been traced over a length of about five miles. The strike of the upturned edges of the beds is about north-west and the dip about 80° to the south-west.

Owing to the softer character of the strata of the Walloon Beds, and perhaps to their general horizontality, the country over which they lie to the west of Ipswich has been levelled down to a peneplain, through which the Bremer River meanders with a very slight fall in its course. As it crosses the harder sandstones of the Bundamba and

Ipswich Beds, however, its fall becomes much steeper, and is marked by rapids at several points about Ipswich, the country meanwhile becoming more hilly and the valley of the river more pronounced.

The level character of the country of the Walloon Beds, and the absence of any sections showing them in contact with the Bundamba series, prevent any clear exposition of the relation between the two series in the field. The general mapping, however, appears to me to lead to the conclusion that the Walloon Beds have been faulted down against the Bundamba Beds along a line running parallel with the axis of the sharp folding to which the latter have been subjected. Traced to the north, this line of junction, and probably of faulting, is cut off by the older Palæozoic rocks, but is apparently continued on as a line of faulted junction between the Walloon Beds and the Palæozoic rocks, with which they come here into direct contact. This probable continuation of the faulting is shown more clearly on Map No. 2 accompanying the first report on the Ipswich Coalfield.* The accompanying plate shows the relation between the Walloon and lower beds south of Ipswich.

There is also the possible explanation that this north-west striking line of junction first between the Walloon Beds and the Bundamba Beds, and then between the Walloon Beds and the older rocks, is an ordinary unconformable junction, representing a stratigraphical break within the Trias-Jura. In any case, there seems no doubt that the Walloon Beds belong to a much higher horizon of that series than the Ipswich and Bundamba Beds.

THE WALLOON BEDS.

The Walloon Beds have not as yet been studied in any detail. Indeed, the rarity of outcrops of rock over the level area to the west of Ipswich, and the absence of much mining or quarrying, precludes any very detailed study of the formation. What little we know of them, however, shows that they possess features which differentiate them from the coal-bearing beds of the Ipswich Field. The coals hitherto found show a characteristic choncoidal fracture in the hand specimen, burns readily with a long, luminous flame, and give off a much larger proportion of volatile hydrocarbons when heated in a closed vessel than do the brittle bituminous coals of the Ipswich Beds. It does not, however, seem possible to draw any distinction between the formations from palæontological evidence, most of the fossils as yet found in the Walloon Beds occurring also in the Ipswich Beds.

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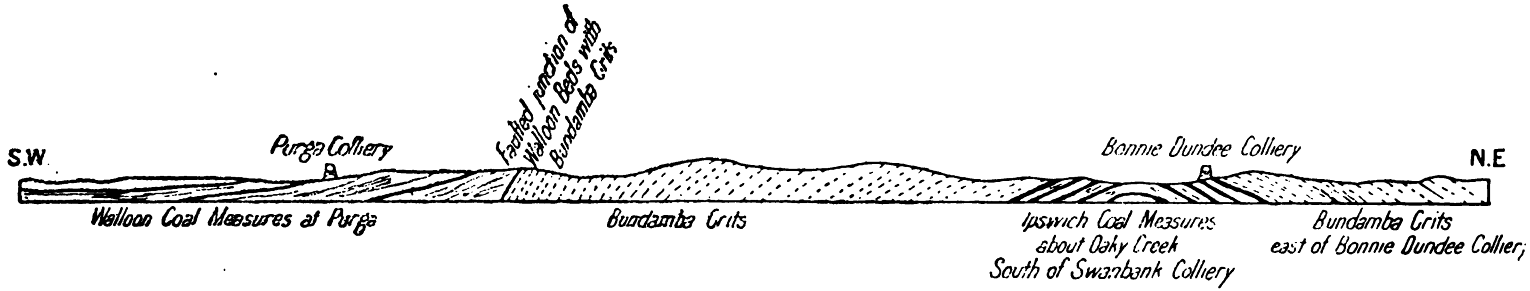
* Geological Survey Publication, No. 147.


S.W.
Purga Colliery
Faulted junction of Walloon Beds with Bundamba Grits
Bonnie Dundee Colliery
N.E
Walloon Coal Measures at Purga
Bundamba Grits
Ipswich Coal Measures about Oaky Creek South of Swanbank Colliery
Bundamba Grits east of Bonnie Dundee Colliery

Section across Trias Jura Beds of Ipswich Coal Fields between Purga and Bonnie Dundee Collieries showing junction of Walloon Coal Measures with lower Series

Scale 80 Chains to an inch

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POSSIBLE DIVISION OF THE TRIAS-JURA SYSTEM INTO TWO STAGES.

The Walloon Beds thus, no doubt, lie on a considerably higher horizon of the Trias-Jura System than the beds about Ipswich. These latter have not been mapped in detail east of Goodna, but there is not wanting evidence that they are continuous to the east with the sandstone and associated coals which are now being prospected about Nundah, continuing thence along the coastal lands between Brisbane and Bundaberg, probably including all these beds, and among them the Burrum Formation.

All the inland belt of Trias-Jura rocks west of Ipswich, on the other hand, is characterised by coals similar in character to those found about Walloon, Rosewood, and Purga, and it seems extremely likely, notwithstanding the as yet negative results of the palæontological evidence, that future more detailed study will impose upon us the necessity of considering the Trias-Jura system as divisible into two stages, an earlier represented by the beds of the Ipswich and Burrum Coalfields, and a later represented by the coalfields of Walloon, Purga, and the Darling Downs.

THE REDBANK PLAINS BEDS.

About the farming district of Redbank Plains there occurs an area of fissile shales which are seen to lie with a more or less distinct unconformity on the coarse grits and sandstones of the Bundamba Beds. They can be traced all round the southern margin of the beds of volcanic rocks, which give the chocolate soil of the plains, and have been sunk on in various shafts for wells along Six-mile Creek and on the farms in the south-eastern corner of this district. They have afforded some fragmentary fish remains and remains of Dicotyledonous plants, which latter circumstance points to a probable identity with the supposed Cretaceous beds found about Darra and Wolston. They appear to lie practically horizontally. Near Jones's Bee Farm they are accompanied by soft felspathic sandstones. A few yards further east the underlying grits of the Bundamba Beds are found lying with varying angles of dip of up to 30° from the horizontal, and give evidence of a more or less distinct unconformity with the overlying shales. The area covered by these presumably Cretaceous beds is shown in green on the map.

BASALTIC AND FELSITIC LAVA FLOWS.

Several large areas of these rocks are shown on the general map, as well as a few isolated patches, which seem to indicate a once almost continuous extension over the whole of this area. From the lighter colour of the soil about Redbank Plains and the more acid character of the weathered specimens of rock that were observed, it seems probable that the lavas in this area were more of the nature of andesite or trachyte, and they have consequently been mapped as felsitic in character as distinguished from the more basic basalts of the other portions.

Chapter II.—The Bundamba District.

I.—DETAILED GEOLOGY.

1. General Disposition of the Beds.

The productive coal measures in the Bundamba district consist of alternating conglomerates, grits, sandstones, and shales, with at least seven well-recognised beds of coal, six of which have been worked at one time or another. They are exposed to a depth of about 1,000 feet from their uppermost beds, the lower beds of the series not being exposed. They are overlain round the south-east, south, and south-west of the area shown on the map by the overlying unproductive series of grits and sandstones which I have called the Bundamba Grits, and have been brought up from beneath these beds by a bending up of the strata over an axis running in a north and south direction across the centre of the field. This bending of the strata forms an irregular anticlinal ridge, with an average maximum dip on either side of about 14° from the horizontal. The beds are thus exposed along their outcrops in descending order along the western side of the field, as it is traversed from west to east, and the same beds are again exposed in ascending order as the eastern side is crossed. The bending up has been most severe about the centre of the northern half of the field, so that the lowest beds are exposed here in the Cooneana Estate. They outcrop over an oval-shaped area, with its longer axis north and south, and with the succeeding higher beds running in duplicate down either side of the field. South of the area at present worked, the bending up of the beds decreases rapidly, and the outcrops of the upper coal beds can be traced round from one side of the field to the other.

The north-eastern corner of the district about Dinmore and New Chum is cut off from the rest of the field by a line of faulting (Stafford and Rhondda Faults on the map), which breaks the regularity of the line of outcrop in this direction. The beds are thrown down to the north-east by this faulting, so that they lie with only gentle inclination over an area of about a square mile and a-half round Dinmore and New Chum, between these faults and the Ebbw Vale Fault, which throws up the beds again to the north-east. The New Chum Seam has been worked by several vertical shafts between these two faults, and has been one of the most important producers of steam coal in the district.

Five years ago this seam was the most productive of any in the district, being pressed closely by the Aberdare Seam, worked at that time solely along the western dip of the measures in the neighbourhood of Blackstone. During the last five years numerous new pits have been opened along the southern extension of the Aberdare Seam beyond Blackstone, and also along the eastern fall of the beds towards Six-mile Creek; so that the Aberdare Seam is now by far the most productive of any in the Ipswich district.

Besides this new work on the Aberdare Seam, several new collieries have also been lately opened up, and prospecting work has been done on some of the lower seams in these directions—in one or two cases with considerable success.

The opening up of these collieries has thus shown the importance of these seams to the district, and has allowed of the mapping of their continuation to the south and east of the older established collieries with a much greater degree of accuracy than was possible five years ago. This has permitted of the identification and correlation of the seams in a much more satisfactory manner. There is still doubt as to the exact position in the series of some of the seams, but it is hoped that the new map will assist in the elucidation of these points in the near future.

The various horizons by which these seams can be traced will now be considered in detail in ascending order.

2. THE COONEANA SANDSTONE.

The lowest persistent bed that is exposed over any considerable area is a sandstone, which is shown on the map to outcrop over a roughly oval hollow area in the northern portion of the map on the Cooneana Estate, and is marked as the Cooneana Sandstone. This sandstone dips out in all directions from the centre, and must be about 100 feet in thickness. Below it is an area of shales, which show few exposures, but give signs of being coal-bearing. From reasons advanced later on, it seems probable that the Cooneana Sandstone is on about the same horizon as the thick bed of sandstone found overlying the Garden and Tantivy seams (the highest seams) in the North Ipswich district, in which case the underlying shales show every likelihood of containing seams of economical value. The Cooneana Sandstone is not exposed elsewhere on the field; but, in a bore put down from the bottom of the New Chum No. 3 shaft, Mr. Jeffries, the manager, tells me that, after passing through shales containing two lower seams, a considerable thickness of soft felspathic sandstone was passed through from 162 feet below the floor of the New Chum Seam. This sandstone I take to be the Cooneana Sandstone, lying, as it thus does, about 400 feet below the next succeeding and easily traceable bed of sandstone immediately above the Four-foot Seam, which I have called the Four-foot Sandstone.

3. THE BUNDAMBA SHALES AND LOWER COALS.

Between these two easily recognisable beds of sandstone is a series of about 400 feet of ferruginous shales, carrying the five lower seams of coal of this district, and several thin bands of soft flagstones. These shales weather to a rusty red soil, which generally gives a sufficient indication of the character of the rock being passed over. The coal seams, in ascending order, have been named Doby's, Rob Roy, Striped Bacon, Bergin's, and the Four-foot.

These seams were first worked near the township of Bundamba, in the north-western corner of the district; and the work extended along the outcrops of the seams in a southerly direction up the eastern side of Bundamba Creek. I have consequently called the beds in which these seams lie the Bundamba Shales. The workings along Bundamba Creek have, however, long been abandoned. In the Dinmore district the important New Chum Seam is one of this series, and has been worked continuously for a number of years. Recently several openings have been made, and two collieries started on seams belonging to this series on the southern and eastern extension of this outcrop beyond Blackstone and Cooneana. Of these, the Rhondda Colliery, on the eastern fall of the beds towards Six-mile Creek, has been the most successful; while in the new pit of the Aberdare Company, on the Four-foot seam, and in Wall's pit, probably on the continuation of Bergin's Seam, a considerable amount of prospecting has been done. Outside the Dinmore district and the Rhondda Colliery, however, but little coal is as yet being turned out from these seams.

On the southern portion of the Cooneana property these Bundamba shales and their accompanying coals dip under the Four-foot sandstone which immediately overlies them. They reappear again further south in the drainage basin of Oakey Creek, and are found over a considerable area where the coals have been exposed in a number of prospecting openings. Up to the present, however, the Swanbank Colliery Company is the only one which has worked them successfully, its operations on the two uppermost coals having been carried on continuously ever since the discovery of coal on the northern bank of Oakey Creek, about 1890.

4. THE FOUR-FOOT SANDSTONE.

The Four-foot sandstone, which is found overlying the Bundamba shales immediately above the Four-foot Seam, forms a readily traceable horizon, which has been mapped with a considerable degree of accuracy over the greater portion of the district. About Bundamba and Blackstone it is some 300 feet in thickness, but further south it decreases in thickness, till, between the Mafeking and Denham pits, it cannot be much more than 150 feet. Its outcrop can be traced round from the western side of the field to the Rhondda Colliery on the east, where it is displaced by the large fault (the Rhondda Fault) lying to the north-east of that colliery. It is again found in the Whitwood No. 3 shaft and on the road in the gullies to the south of that colliery. About the centre of the area mapped, south of the Cooneana Estate, this sandstone covers the lower Bundamba shales and lower coals over a considerable area to the east of the Bogside and Mafeking mines, stretching across the crest of the anticline from west to east. It has been brought down here by a slight troughing of the beds under an east and west axis of bending.

On the hill above the Swanbank Colliery this sandstone is intercalated with beds of coarse, pebbly conglomerate, which was formerly supposed by the writer to be a continuation of that overlying the Aberdare Seam about Blackstone, but which the detailed mapping, rendered possible by the opening of the collieries about Box Flat, and the prospecting work incidental to this work, has shown to be bent much further to the east over a north-westerly striking axis, passing through the Denham Colliery and the north-western levels from the Swanbank Mine. The conglomerate can be traced across to the south of Oakey Creek, and the sandstone still further followed in a sweeping circle round the southern portion of the map to where the underlying Four-foot Seam has been opened by several shallow shafts near the Bonnie Dundee railway line.

The Four-foot sandstone, with its accompanying pebbly conglomerate overlying the Swanbank Seams north of Oakey Creek, can be traced south across the creek, where the Swanbank No. 1 Seam was again opened out by two inclined slopes on portion 5, but with no very promising indications.

North-west from Swanbank the sandstone can be traced through portions 130, 134, and 135 to 147, on the northern end of which a shaft passed through the lower portion of the sandstone and exposed the Four-foot Seam. At this point the continuity of the beds seems to be broken by a fault, as a second shaft, a little further south, has not met either the sandstone or the coal. The sandstone is shifted further east, and its probable continuation from here round to portion 5 is only mapped in from its known relation to the overlying beds which have been followed round further south.

5. THE ABERDARE SHALES AND OVERLYING BUNDAMBA GRITS.

Above the Four-foot sandstone is another bed of shales about 100 feet in thickness, and containing two persistent seams of coal—one near the bottom, known as the Bluff seam, and the other near the top, known as the Aberdare Seam. The position of these shales can be traced most readily over the whole district by means of the overlying grits and sandstones, which form conspicuous outcrops marked by many ridges and abrupt escarpments. The Aberdare Seam, the most valuable in the district, was first worked under the conspicuous hill to the south of Blackstone, formed by the outcrop of these grits and coarser beds of conglomerate. It was the tracing of this series of coarse and hard beds to the south and east of Blackstone, and the consequent mapping of the underlying coal, which encouraged the opening up of the four new pits along the eastern margin of Box Flat, and the still more recently opened mines along the eastern fall of the beds near Six-mile Creek.

II.—THE SEAMS.

1. THE ABERDARE SEAM.

This seam is at present the most productive and most sought after seam in the district. Its yield increased from 31 per cent. of the total output of the district in 1899 to 55 per cent. in 1904, the output of the New Chum Seam, the second most productive, having dropped in the same time from 38 per cent. to 21·5 per cent. of the total. In 1898 the Aberdare Seam was worked in only two collieries—the Aberdare and West Moreton Collieries, situated on the western dip of the beds near Blackstone. Since then four new collieries have been opened up along the southern extension of the outcrop past Box Flat, the southernmost working being about 2¼ miles from the northernmost levels of the Aberdare Colliery. The shaded portions on the map show the positions of these workings, and roughly the extent to which the seam has been worked.

The Aberdare Seam has a good reputation as a steam coal, and has given high evaporative results wherever it has been tried. It produces very little clinker, and a relatively small proportion of ash.

Fig. 2 is a section of the seam, taken by myself, in Walker's Fairbank Colliery. This section shows about 11 feet of coal in about 14 feet of coal and bands, and is fairly representative of the character of the seam about Blackstone. As it is followed to the south, the lower section of 4 feet becomes thinner and of poorer quality, while in the Aberdare Mine, to the north, this section was worked 5 feet in height, over a large area. The seam is worked in two sections. In some cases a top section, down to the 68½-inch mark on the diagram, is taken down first, the bands of stone being picked out before filling. From the 68½-inch mark to the 96½-inch mark is then left as a roof above lower rooms, which are worked immediately underneath on the lower section from the 96½-inch mark to the bottom. In other cases, where the section below the stone, called the "badger" (shown on the figure), is poor, the first section is taken down to the 88½-inch mark in the figure. The 8-inch band of stone is then stripped by yardage, and the underlying 18½ inches of coal lifted, the coal below the "badger" not being worked.

COLLIERIES ABOUT BLACKSTONE ON THE ABERDARE SEAM.

Aberdare, West Moreton, and Borehole Collieries.—The underground workings on the map show the extent to which this seam has been worked. The Aberdare Colliery was the first opened out on the seam, being started by Mr. Lewis Thomas, of Blackstone, on the shallow and easily-mined coal lying under Blackstone Hill. The contour of the ground throws the main outcrop back to the east of the hill, at the same time exposing the seam again as an oval-shaped line on the map on the western fall of the hill. From this outcrop drives were put in to the rise of the coal and on this level, and the coal run out at a trifling expense on to a branch railway line coming up the gully that exposes the outcrop.

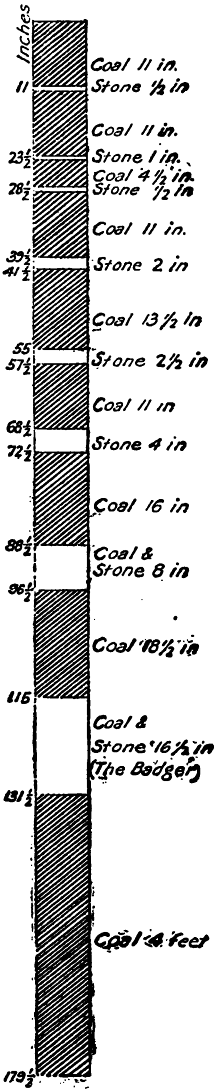

Fig. 2

SECTION OF ABERDARE SEAM IN WALKER'S FAIRBANK COLLIERY, BOX FLAT.

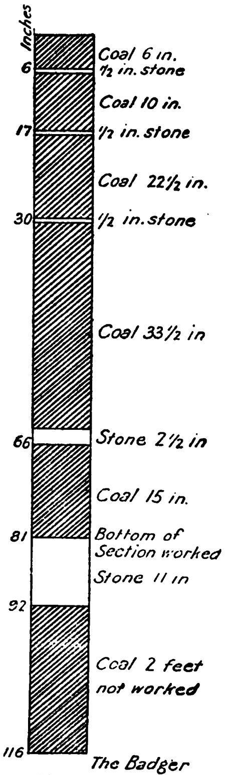

Fig. 3

SECTION OF ABERDARE SEAM IN NEW WEST MORETON COLLIERY.

The Aberdare Colliery still takes the lead in output of any colliery in the State, with a yearly production of about 60,000 tons. The workings now extend some 50 chains to the dip of the outcrop, and

20 chains from the dip of the No. 3 (or Coolgardie) shaft, from which the coal is now all mined. The No. 3 shaft is 523 feet deep, and the workings have been extended some 1,800 feet to the north. The grade is almost due west, at an angle of about 14 degrees, or 1 in 4. This has brought the bottom of the dip to a vertical depth of nearly 900 feet below the level of the shaft head, or 1,000 feet below the level of the ground above. Trouble with water has prevented further sinking of the dip. Most of the coal is being won from the levels going north from the dip from the No. 3 shaft. As they go north these levels bend round to the west, the dip of the coal swinging round till, under Silkstone, it is about south-south-west.

The importance of this fact is that the strike of the coal, which is obscured north of the village of Blackstone by the alluvium of Bundamba Creek, is thus proved to swing round under the basalt capping the coal measures here towards Booval Station, thus bringing the coal to within shallow depths along the Brisbane road, in close proximity to the railway line. The strike of the coal beds further west is shown to still curve round under the basalt, for, at the town of Ipswich, the strike is almost south-west, and the dip south-east towards Blackstone. Accordingly, the Aberdare Seam, which dips west under the basalt area in the Coolgardie Mine, must necessarily flatten as it is traced further to the dip, and rise again on the western side of the basalt under the town of Ipswich. The greatest depth in a line due west of the Coolgardie Mine cannot thus be much over 2,000 feet, and there must consequently be a considerable area of country within easy reach of the main line at Booval, under which it is probable that the Aberdare Seam exists in good quality, and nowhere at a greater depth than 2,000 feet.

The Aberdare Seam has also been worked over a considerable area to the south of Blackstone, from the Aberdare No. 2 and West Moreton shafts. The workings from the former shaft extended to a distance of about ½ mile to the east of the shaft, the level course here swinging round to almost due east. The swinging round of the dip is clearly shown by the tracing of the underground levels on Map 2. The workings were blocked by a fault, and, owing to fires in the gob, they had to be abandoned. The West Moreton workings to the south also met with troubled ground, the coal being apparently thrown up to the south-west by a fault striking in a south-easterly direction across the drive to the south. An attempt was made to find the coal on the further side of this fault by sinking a second shaft (No. 2 shaft), the position of which is shown on the plan. Unfortunately for the promoters of this scheme, the position chosen lay in the centre of an altered dyke of igneous rock which here cuts through the coal; and, after 85 feet of sinking, the work was abandoned. These dykes are common to the district, and do not seriously affect the quality or position of the coals; so that, had a position been chosen a little to the east or west of the dyke, in all probability the seam would have been struck at no great depth, and a large area of land have thus been opened up successfully. This failure led to the seeking of coal lands elsewhere, and ultimately to the tracing of the seam round the eastern side of Box Flat, as shown hereafter.

North of the village of Blackstone, the Borehole Colliery also worked the Aberdare Seam, by means of a shallow shaft and stope. This colliery has been opened up again lately, having been idle for many years. It is not yet on the list of steady producers.

COLLIERIES ABOUT BOX FLAT ON THE ABERDARE SEAM.

Fairbank, Box Flat, Bog Side, and Mafeking Pits.—Since the date of the writer's last report (1899) these four collieries have been successfully opened up on the southern extension of the Aberdare Seam across the level country of Box Flat. They extend over a length of about 1 mile along the outcrop. Being situated close to an already existing railway line, and starting on the outcrop of a thick seam of coal of good quality, they have been able to mine large quantities at very cheap rates, and have thus been able to compete successfully against the older-established mines with their handicaps of long underground haulages. Their success has demonstrated the continuation of the Aberdare Seam, with little deterioration of quality or thickness, over a large area which was virgin ground at the time of the writer's previous report on the field. In that report the probability of the extension of the Aberdare Seam under the whole of the area embraced by Box Flat and the ridges lying immediately to the north-east was pointed out, and the probable position of the outcrop was drawn in on the accompanying map. The results obtained by these four collieries during late years is a striking example of the advantage of having coal at shallow depths. During last year the four pits, out of a total of twenty producers, secured over 37 per cent. of the trade.

As yet little more than the coal within a few chains from the outcrop has been extracted, though, owing to the steep dip of the beds, the coal is rapidly being carried to depths which are, in some instances, making trouble for the light hauling appliances installed for shallow working along the outcrop. The area of ground underlain by the Aberdare Seam to the east of Bundamba Creek, in this locality, is bounded on the north by the old Aberdare workings, and on the south by a bending-up of the beds, which rapidly throws the outcrop of the seam out to the west between the Mafeking and Swanbank Mines. The Box Flat Colliery, which includes the greater portion of the deeper ground over this area, has commenced deeper mining by sinking a vertical shaft, 405 feet in depth, about 16 chains from the outcrop, and has installed a winding-plant capable of dealing with a considerable output. This colliery also has lately installed the first coal-cutting machine employed on this field.

The levels from the bottom of the shaft show a flattening dip going north, and a steepening dip going south. The flattening of the dip going north should bring the coal to shallow depths over a large area between the Box Flat workings and the Aberdare No. 2 workings, and over the south-eastern corner of portion 286. The amount of ground still untouched here and at a depth of less than 400 feet should not be less than 100 acres. The probability is that the Aberdare Seam is nowhere more than 700 feet in depth to the east of the Swanbank Railway Line, which should give about Box Flat an area of coal still untouched, and at a less depth than 700 feet, of over 260 acres.

CONTINUATION OF THE ABERDARE SEAM SOUTH OF BOX FLAT.

The Mafeking pit of the Swanbank Collieries Company, towards the southern end of Box Flat, is the furthest southern working on the Aberdare Seam. The mine consists of a slope driven nearly due west on the dip of the seam for a distance of about 350 yards. The level going south met a fault at about 200 yards south of the main dip, which cuts off the coal and has thrown it up a vertical distance of about 100 feet, bringing the next lower seam--the Bluff Seam—into juxtaposition with the Aberdare in one of the levels. South of this fault the coal has been lately picked up by Mr. Harris, the manager, in prospecting workings on the northern slope of Mafeking Hill, and the outcrop has been traced over the brow of the hill on to its eastern and southern slopes. In this locality the strike of the coal has been changed, as mentioned above, by a bending up of the strata over a north-westerly running axis of folding, so that the dip has been altered to a direction a few degrees west of north, and the continuation of the line of outcrop is thrown round into a westerly direction. The line of outcrop is further deflected, as it is followed down the slope of the hill, by the lowering of the ground into a direction north of west. Beyond this point the continuation of the line of outcrop is uncertain. The bending back of the beds, however, over the north-westerly axis above referred to, which is evidenced by the workings on the lower seams in the Denham and Swanbank Collieries, should bring the coal back into about the position indicated by the broken line on the map. This area of ground is covered by the alluvium of Bundamba Creek, under which the outcrops of the seam and that of the overlying beds of sandstone are hidden, so that its position cannot be indicated with any degree of certainty.

The overlying beds of grit and sandstones usually found above this seam are again observed along the eastern side of Ivory's Lagoon, and can be traced by numerous outcrops in a half circle round the extreme south of the map.

On the heads of Oakey Creek Mr. W. Binnie recently opened a shaft, which I have no doubt is on the same seam. The seam is overlain by a thick mass of sandstone, which is passed over in a traverse further up the creek, and can without doubt be traced continuously to the known outcrops of the seam both to the north and west.

Mr. Binnie informs me that he found no workable section of coal in this seam, and this fact is decidedly disappointing, if the shaft proves, as I have no doubt it will, to be on the continuation of the Aberdare Seam. It shows that in the locality of this shaft, at any rate, this excellent seam has deteriorated so much in quality and thickness as to be unworkable.

NEW COLLIERIES ON THE EASTERN FALL OF THE ABERDARE SEAM.

The Bonnie Dundee, New West Moreton, and Fernie Creek Mines.—The grits and conglomerate overlying the Aberdare Seam are again found along the western side of Six-mile Creek, from the heads of Oakey Creek to the mouth of Fernie Creek, forming a series of rough stony ridges. The Aberdare Seam has been opened up by three new collieries along the western slope of these ridges. The Bonnie Dundee Colliery lies on one of the heads of Oakey Creek, and the New West Moreton and Fernie Creek Collieries near the heads of Fernie Creek. These mines are served by the newly-opened continuation of the old Swanbank Railway Line in the case of the Bonnie Dundee, and by a branch line from the Bundamba loop-line in the case of the other two mines.

In the *Bonnie Dundee Mine*, the thickness of workable coal has decreased considerably from that in the mines on the western fall of the beds, but the seam has not been sufficiently opened up to allow of a proper estimate of its value being formed. The height of the coal being worked varies from 4 feet 8 inches to 5 feet, with two small bands 6 inches from the bottom. From the top of the seam to the bottom of the overlying sandstone are about 8 feet of unworkable coal and stone bands. This seems to indicate that the Bonnie Dundee Seam represents the upper portion of the Aberdare Seam, the lower portion being absent.

The overlying sandstones and grits above the Aberdare Seam can be traced in a northerly direction from the Bonnie Dundee Mine to the *New West Moreton* Colliery, where the seam has been opened out by two slopes on the dip of the seam and a drive along the course of the seam under Black's Hill. Fig. 3 is a section of the seam measured in the face of the rooms driven to the rise of this level.

This section corresponds with that of the Abedare Seam above the "badger" stone in the Bog Side and Fairbank Collieries on the western side of the field, except that the bands of stone are thinner, and the

total thickness about 6 inches less. The 2 feet of coal at the bottom of the section is not worked, and the coal below the "badger" is not exposed, being on this side of the field too rough to work.

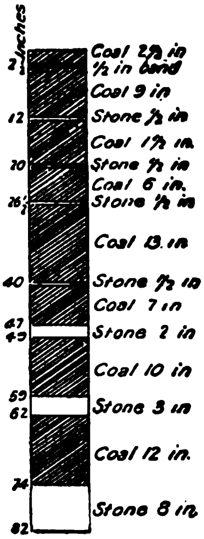

Fig 4

SECTION OF ABERDARE SEAM IN FERNIE CREEK COLLIERY.

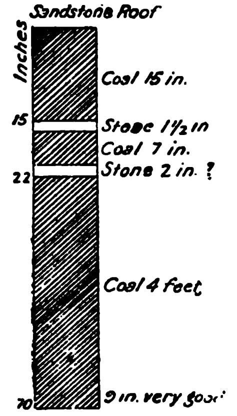

Fig. 5

SECTION OF FOUR-FOOT SEAM IN SLOPE OPENING NEAR WALKER'S FAIRBANK COLLIERY.

In the No. 2 slope the whole section of the seam has been exposed, and it shows the section of the coal below the "badger" to be about 2 feet 2 inches in thickness, whereas on the western side about Box Flat this section of coal runs from 3 feet to 4 feet, and in the Aberdare Colliery was worked over large areas to a thickness of 5 feet.

The *Fernie Creek Colliery* has recently been opened on the Aberdare Seam, about 20 chains north of the New West Moreton Mine, and is fed by a branch line from the railway to that mine. The seam outcropped on the western fall of a steep spur, formed by the overlying grits and conglomerate, and has been opened by a slope driven almost due east along the dip of the seam, which is here about 14 degrees. Fig. 4 is a section of the coal worked, and evidently represents the top section of the Aberdare Seam. The bottom section is said to be wanting entirely.

CONTINUATION OF THE ABERDARE SEAM NORTHERLY FROM FERNIE CREEK MINE.

The sandstones and grits overlying the Aberdare Seam at Fernie Creek can be traced across the eastern part of portions 286 and 283 and the Redbank Plains road to the north-western corner of portion 282. At this point a vertical shaft has been sunk under the sandstone to a depth of about 200 feet, but no workable section ot coal was found. Apparently the Aberdare Seam has deteriorated in this direction into nothing but coaly shales. Whether it makes again into good coal east of Six-Mile Creek is still unproved. Geological considerations point to the inference that it is represented further east by the uppermost seam worked under the sandstones of Goodna and Redbank; and if this is the case it does not return to anything like the same quality and thickness possessed by it in the Bundamba district.

2. THE BLUFF SEAM.

This seam has not yet afforded a workable section of coal in any portion of the field, though it has been exposed by prospecting shafts and drives at numerous points over the Bundamba district. It has been possible, by means of these prospecting workings, to map the outcrop of the seam over the greater part of this district. A recent measurement (made by Mr. Harris, manager of the Swanbank Collieries) of the seam as disclosed by a shaft sunk near the Mafeking Pit, shows about 20 feet of bands of stone and coal, the thickest clean band of coal being about 2 feet 1 inch of inferior quality, and no workable section being present. The seam apparently maintains this character over the greater portion of the district.

3. THE FOUR-FOOT SEAM.

This seam can generally be easily identified over the greater portion of the district from the fact that it lies immediately under the first thick bed of sandstone under the Aberdare seam. It generally shows about 4 feet of clean coal at the bottom, with two bands of white stone (divided by a thin band of coal, making about 7 inches in thickness) above, and separating it from another 15 inches of top coal. Between this top coal and the overlying sandstone there is often a foot or so of shale, but in many places the top coal is immediately overlain by the sandstone.

The seam was originally worked on the eastern bank of Bundamba Creek, between Bundamba and Blackstone, in the old Rosehill, Borehole, and Braeside Collieries, in workings long since abandoned. It has recently been opened up by the Aberdare Company immediately to the south of Blackstone by a slope on the dip, about 100 yards in length. The seam here shows about 9 inches of good coal at the bottom, and then about 1 foot 6 inches of rather rough coal, which is difficult to separate in working, and causes a good deal of trouble. The seam can be traced to the south by the overlying sandstone, past a slope put in by Walker Bros. on portion 295, and another put in by Messrs. Auld and Co., on the north-western corner of portion 286, to the ridge crossed by the loop-line between Wall's Mine and New West Moreton branch line. The coal was opened out on the top of the ridge, and again immediately east of the branch line. None of these positions have, however, been developed for producing coal. The section

of the seam shown in Fig. 5, and given me by Messrs. Walker Bros., from the opening on their ground, is fairly representative of its character.

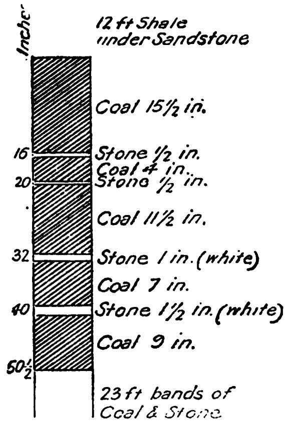

Fig. 6

SECTION OF BERGIN'S SEAM IN SHAFT SUNK BY WALKER BROTHERS ON PORTION 295.

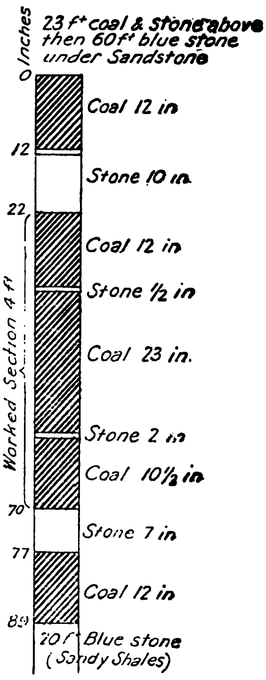

Fig. 7

SECTION OF RHONDDA SEAM IN RHONDDA COLLIERY.

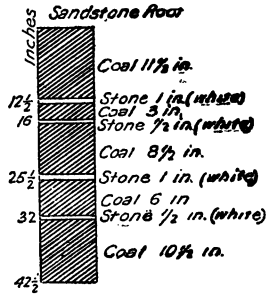

Fig. 8

SECTION OF SWANBANK NO. 1 SEAM IN SWANBANK COLLIERY, AS GIVEN BY THE LATE MANAGER (MR. WOOLLEY).

CONTINUATION OF THE FOUR-FOOT SEAM NORTH OF FERNIE CREEK.

The thick bed of sandstone overlying the Four-foot Seam can be traced across the Redbank Plains road, through portions 281 and 283 to the Rhondda Colliery, where the underlying coal has been exposed by three prospecting holes. In the north-eastern corner of portion 273 a fault has been disclosed by prospecting operations in a gully. This fault apparently cuts off the coal to the north-east, throwing it down in that direction, as shown on the map. This fault can be traced by

exposures in the gullies through portions 275, 270, 271, and 267, where it joins Gilliver's cutting fault coming through the Whitwood workings. In these portions the sandstone is brought down to the north-east by the fault, and it has been pierced by the Whitwood No. 3 shaft on portion 267 for a depth of 30 feet. Below this depth the shaft passed through coaly shales, which are apparently all the traces left of the Four-foot Seam in this direction.

SEAMS BELOW THE FOUR-FOOT SEAM.

The well-defined belt of shales and coal, which I have called the Bundamba Shales, contain, besides the Four-foot Seam at their top, four other seams, all of which were worked to some extent along the western fall of the bed between Bundamba and Blackstone. These workings have all been abandoned for some years. Lately, two new collieries have been opened up on coals occurring in these beds on their eastern fall towards Six-mile Creek.

4. Bergin's Seam.

This seam was first worked by Bergin on portion 161, east of Bundamba Creek, and subsequently by Lindsay Bros., on portion 159. It was also, I believe, worked on portions 163 and 164. These working have long since been abandoned. Walker Bros. have sunk a shaft on the same seam, on portion 295, in which I measured the section shown in Fig. 6. Below the bottom layer of coal are, according to Mr. Walker, senior, another 23 feet of coal and stone bands.

A seam of coal has recently been opened up in Wall's Mine, which I estimate to be about 70 feet below the Four-foot Sandstone, and which, consequently, corresponds in position to Bergin's Seam. At the top is about 4 feet 6 inches of coal, with bands of stone, which apparently corresponds with the seam at the top of Walker's shaft. Below this are 26 feet of coal and stone, which corresponds with that underneath the coal in Walker's shaft. At the bottom is 11 inches of coal, separated by 5 inches of thin shale from another 2 feet of coal. This latter section forms the main section of coal worked in Wall's Mine. Below this seam is about 3 feet 6 inches of blue shale, and then 3 feet 5 inches of coal, with three bands of stone, which forms the lower seam of Wall's workings. The continuation of this seam round to the north-east is shown on the map, and if it keeps at the same distance below the Four-foot Seam, its outcrop should pass a few yards east of the Rhondda shaft on portion 276.

5. The Striped Bacon and Rhondda Seams.

The Striped Bacon Seam was also worked by Lindsay Bros. on portions 245 and 159, near Bundamba, and was also opened up further south on portion 161, and in the Borehole property on portion 173; but these workings have long since been abandoned. From the position of the Rhondda Seam, below the Four-foot Sandstone in the

Rhondda Colliery, I judge the seam worked there to be the same, though the matter can hardly be considered quite certain.

Fig. 7 is a section of the Rhondda Seam. In this case 23 feet of coal and stone bands, under a thin sandstone, were passed through before reaching a workable section near the bottom. The coal is of good quality, and the colliery has advanced rapidly into the front rank as a producer. As shown later, this seam is probably identical with the New Chum Seam, which has been proved of such great value in the Dinmore district, and has proved that the latter seam continues in this direction in good quality, thus opening up possibilities of a large area of ground carrying this seam to the south of the Dinmore Fault. The Rhondda Colliery is served by a branch line from the Bundamba loop.

6. The Swanbank Seams.

THE NO. 1 SEAM.

The Four-foot sandstone overlying the Four-foot Seam, where it was opened out by Walker Bros. and Auld and Co. on portions 295 and 286 respectively, can be traced round to the east of the Mafeking Mine, as far as the south-eastern corner of portion 19. It is here bent up over the same north-westerly running anticlinal axis as the seams above it. This gives it a south-westerly strike across the head of the gullies on the northern end of portion 12, and brings it on to portion 13, where it changes to a coarse pebbly conglomerate, forming a steep escarpment along the eastern boundary of that portion. The Swanbank Seams crop out under this escarpment, the No. 1 seam of the Swanbank Mine lying immediately below the conglomerate bed. I therefore judge this seam to be the continuation of the Four-foot Seam.

Fig. 8 is a section of the seam as it was worked in the Swanbank Colliery. In this locality the Four-foot Seam appears to have decreased considerably in thickness, showing only 42 inches in place of 70 inches of stone and coal. The top coal has decreased from 15 to 11 inches, but the two white stone bands, separated by a band of coal, are still present. The bottom coal has decreased to 26½ inches, and shows two distinct bands of stone about the middle. In spite of these differences, however, the fact that the seam lies immediately under a sandstone roof, which can be traced right round from the slope of the Aberdare Company on the Four-foot Seam past Walker's slope opening to the Swanbank Mine, leaves little doubt in my mind that the No. 1 Swanbank Seam is a continuation of the Four-foot Seam. The seam has been very little worked in the Swanbank Colliery.

THE SWANBANK NO. 2 SEAM.

This seam lies about 67 feet below the No. 1 Seam in the Swanbank Colliery, and thus corresponds pretty well in position with that known as Bergin's Seam about Blackstone. The seam here is characterised by about 4 feet 6 inches of coal under a shale roof, and is separated from a lower section, running from 2 feet 6 inches to 3 feet 3 inches in thickness by 1 foot to 18 inches of shale. Below this again are bands of shale and coal, which, however, have not as yet afforded workable coal. This seam has been worked over a considerable area in the Swanbank Mine, on the south-western dip of the beds north of Oakey Creek. These workings have been abandoned, but the seam has again been opened out under the west of Swanbank Hill by a drive in through the overlying conglomerate to meet the seam, and a slope on the seam towards the north east. This is the Denham Colliery. The slope at first went about half-course, the dip being nearly due west. As it went further down, however, the dip swung round till, at the bottom, where the slope has been turned almost due north, it is following down the dip of the seam. This shows that the strike of the Swanbank seams is here almost east and west, and must necessarily bring their outcrops considerably to the east of Mafeking Hill. The Denham slope, in fact, crosses over the crest of the area of folding shown on the plan, and at once gives an insight into the relations between these seams and that worked in the Mafeking Tunnel.

7. Perkins' Seam.

This seam has been exposed by a cutting into the eastern face of Swanbank Hill, on portion 12. It is apparently about 130 feet below the Swanbank No. 2 Seam, and this distance agrees well with the distance between Bergin's and the Striped Bacon Seams about Blackstone. I have no doubt that Perkins' Seam is the continuation of the latter. The seam does not show any workable section in the cutting mentioned above.

8. The Dinmore Seams.

COMPARISON WITH BUNDAMBA SEAMS.

As shown in the section treating of the general disposition of the Bundamba Beds, the north-eastern corner of this district is separated from the larger portion by a fault of considerable magnitude (the Dinmore Fault), which throws down the beds about Dinmore into a gently inclined position over a considerable area. In this area the New Chum Seam has been worked from a number of vertical shafts in the Whitwood, Dinmore, New Chum, and Ebbw Vale Mines. The extension of the workings to the north-east is again limited by a roughly parallel fault in the two latter mines, known as the Ebbw Vale Fault. The fall of the ground towards Six-mile Creek causes the New Chum Seam to crop to the surface in the gullies draining east into this creek. It was by drives into these outcrops that this seam was first worked, the workings gradually extending to the west and south and north. The relation between the New Chum Seam and those lying on the west of the field has long been a matter of conjecture, but recent work on the area has, I think, settled the matter with a considerable degree of certainty. A second fault, lying between the two main faults, but striking in a more easterly direction, and with a strong up-throw to the south, brings the coal to the surface south of the old New Chum workings, and exposes it in a gully on portion 268. At this point the seam was formerly worked by a slope running towards the southern corner of the portion, but the workings have been abandoned for a number of years. In order to work the coal lying to the west of these workings on portions 267, 270, and 271, Messrs. Stafford Bros. have recently sunk a vertical shaft on portion 267. This shaft cut through the bottom coal of the New Chum Seam, at a depth of 245 feet. The seam dips south at an angle of about 1 in 6. For the first 30 feet the shaft passed through sandstone, which can be seen outcropping on the surface further south, and which I take to be the Four-foot Sandstone, and which is traceable, with little possibility of error, right round through the Cooneana property from the Blackstone side. Below this sandstone were about 70 feet of shales. Immediately below the sandstone should lie the Four-foot Seam, but I understand that it was represented here by a few feet of coaly shale.

At the bottom of the 70 feet of shale was the old Aberdare Seam, which has been opened up by a slope on portion 268, and is characterised by about 7 feet of coal with thin bands of stone, underlain by about 30 feet of coal and stone bands. The position of this coal in shales about 70 feet below the Four-foot Sandstone, and, showing a section of about 37 feet of coal and stone, corresponds very well with the position of Bergin's Seam, as opened by Messrs. Walker Bros. on portion 295, and I have no doubt that it is the same seam.

About 125 feet below the old Aberdare Seam—*i.e.*, at a depth of 218 feet—the top coal of the New Chum Seam was met with, and the floor of the bottom coal cut at 245 feet. This makes a distance of 116 feet between the floor of the old Aberdare and the floor of the New Chum No. 1 Seams. Taking, for the moment, the old Aberdare Seam as identical with Bergin's Seam of the Blackstone area, the New Chum No. 1 Seam should be identical with the Striped Bacon Seam of the same area. The distances between Bergin's Seam and the Striped Bacon, as estimated by myself from the shafts sunk on the two seams by Messrs. Walker Bros. on portion 295, near the Fairbank Colliery, is about 128 feet; so that the distance between the two seams in the Whitwood No. 3 shaft corresponds very closely with that between the two seams at Blackstone. There seems to me very little doubt that these seams are identical each with the other.

In the Braeside Colliery shaft at Bundamba the distance between Bergin's and the Striped Bacon Seams was given to me as 100 feet. In the New Chum No. 3 shaft there is about 14 feet of coal and stone bands between the New Chum bottom and top seams, and about 40 feet in all of coal measures; whereas at Bundamba a third seam—the Rob Roy—is said to occur 30 feet below the Striped Bacon, so that it seems probable that these coal measures, in which these two seams occur at Bundamba, are represented by the 40 feet of coal measures containing the New Chum Seams at Dinmore, the workable sections of coal at one place not occurring in exactly the same part of the section in the two localities.

The New Chum No. 2 Seam, with about 5 feet of coal, was found by boring by Mr. Jeffries, manager of the New Chum Mine, 74 feet below the New Chum bottom coal, and the New Chum No. 3 another 68 feet below. The former apparently has no representative worked on the Bundamba side, but the latter corresponds in position with the Braeside hard coal found in the Braeside shaft at about 147 feet below the Rob Roy. About 30 feet below the New Chum No. 3 Seam a soft felspathic sandstone was entered. I take this sandstone to be identical with the Cooneana Sandstone mapped over the western and southern portions of the field below the "Bundamba Shales."

9. The New Chum Seam.

The bottom coal of the New Chum No. 1 Seam, generally known as the New Chum Seam, is the only one that has been extensively worked in this district. The section worked shows from 3 feet 8 inches to 5 feet of clean coal, separated by two bands of white stone with coal between, from about 15 inches of coal above. This section resembles very closely that of the Four-foot Seam about Blackstone, and the two have often been supposed to be identical. The fact, however, that the latter seam lies immediately below the Four-foot Sandstone, while the New Chum Seam has about 20 feet of coal and stone, with 8 feet of coal of the top seam above it, and then 180 feet of shales, in which occurs the old Aberdare Seam above that, proves conclusively that there can be no connection between the two. The New Chum Seam has supplied a large proportion of the coal for steam purposes from the Ipswich district for a number of years, its output during 1904 being 21·5 per cent. of the total production of the district. The shading on Map I. shows the extent to which this seam has been mined.

III.—FUTURE PROSPECTS OF THE BUNDAMBA DISTRICT.

Ninety per cent. of the output of the Ipswich district for 1904 was maintained by thirteen collieries, there being twenty-one mines in all on the producing list. This gives an average of 27,000 tons per colliery per annum for the most important collieries, or about 90 tons per working day. The premier position for many years has been held by the Aberdare Colliery, which last year again headed the list, with an output of nearly 60,000 tons, an average of 200 tons per working day.

It will thus be seen that in no case can the output be considered large enough to allow of economical working of the seams at any considerable depth, the number of separately managed collieries being greatly in excess of the requirements of the trade. The output of most of them is thus rendered fitful, and necessitates their lying idle for many working days of the year.

The competition of the last five years has led to a gradual reduction of prices, from an average of 7s. 11½d. at the pit's mouth in 1899 to 5s. 11¼d. in 1904. Notwithstanding this great reduction in prices, most of the newer collieries have been able to open up their properties profitably, and have secured a large proportion of the trade. Thus the four new pits along the Aberdare Seam south of Blackstone produced in 1904 over 37 per cent. of the total output. Their operations have, I understand, been generally profitable, notwithstanding the initial expense involved in building spur lines to their pit mouths, and the erection of pit-head frames and haulage gear, and the greatly reduced prices of the coal. This has no doubt been possible by reason of the large quantities of cheaply workable coal provided by the outcrop of such a thick seam. The reduction in cost of coal to the consumer, though pressing hardly on operators accustomed to higher prices, was absolutely necessary in face of the keener competition of southern coal, induced by the general lowering of price there, and the removal of the import duty since federation. An average cost at the mines of 5s. 11¼d. per ton should prove sufficiently remunerative in the shallow workings of the Ipswich district were output continuous, and were the expenses of development and management not multiplied amongst so many small mines lying close alongside of each other, and often workable from the same opening.

As shown before, the chief hope of increased demand at present is that of a constantly enlarging shipping trade at the port of Brisbane. In this connection the extension of the run of the ocean liners of the Orient Company and their announced intention of making a trial of Ipswich coal are hopeful features. A few such regular customers, with facilities for rapid loading, would soon lead to a revival of trade, and put the industry on a more satisfactory footing. With the prospect of an expanding oversea trade from Southern Queensland, this field, situated as it is within a few miles of the port, and with large areas of cheaply-mined coal of good quality still untouched, should have a future of steady prosperity before it.

The Aberdare Seam at the present time furnishes nearly 58 per cent. of the total production of the field, two-thirds of its total coming from the four mines about Box Flat; another 21½ per cent. is derived from the New Chum Seam; so that these two seams furnish the bulk of the coal of the district. This circumstance is due to the fact that these seams are of first-rate quality for ordinary steam purposes, and on account of their both affording a considerable thickness of clean coal, they can be economically mined. Any immediate expansion of demand will, therefore, be probably met by increased drafts on these seams.

As shown before, the workings on the New Chum Seam have hitherto been confined to the ground immediately to the south and west of Dinmore. Recently, however, work has been extended to the west by the opening up of the Whitwood No. 2 shaft to the north of the railway line, and to the south by the Whitwood No. 3 and Rhondda shafts. In the latter direction the finding of the seam in good workable condition in the Rhondda Mine has opened up the probability of the existence over a large area of workable ground in the south-western corner of the field, none of which has as yet been prospected for this valuable seam of coal. Indeed, round the whole of the southern portion of the Cooneana Estate this seam has, as yet, not been prospected, its importance in this area having been overshadowed by the still more valuable and more easily traced Aberdare Seam, lately opened up in the collieries about Box Flat and at the head of Fernie Creek.

The outcrop of the Aberdare Seam, as shown on the map, runs down each side of the field in a roughly U-shaped line, the workings, as yet, all being north of the east and west road up Oakey Creek. To the north-west the country around Booval yet remains to be developed, while the northern extension along the eastern limb seems to be bounded by an area of poor coal as the outcrop approaches Six-mile Creek.

As previously shown, there is still a large area of country with coal at shallow depths east of the Swanbank line about Box Flat, while further south the outcrop of the seam has yet to be prospected over a long line extending up the flats of Bundamba Creek and round the southern portion of the map.

South of the Bonnie Dundee Mine no prospecting, except the shaft sunk by Mr. Binnie on portion 152, has as yet been undertaken; so that there is possibly a large area of shallow-lying coal along the outcrop here yet to be exploited, though the poor prospects found in this shaft are not very promising for this neighbourhood.

Besides these two seams of first-rate importance are the intermediate seams represented by the Four-foot and Bergin's Seams, which also contain valuable sections of coal in certain areas, and which have been worked with some success at detached points.

It is thus certain that the resources of the area embraced by the general map will be sufficient to meet any increase likely to occur in the demand for some years.

Brisbane, 30th September, 1905.

By Authority: George Arthur Vaughan, Government Printer, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

(B. DUNSTAN, ACTING GOVERNMENT GEOLOGIST.)

PUBLICATION No. 203.

GRAPHITE IN QUEENSLAND

WITH SPECIAL REFERENCE TO THE MOUNT BOPPLE GRAPHITE DEPOSITS.

WITH FIVE PLATES.

BY

B. DUNSTAN, F.G.S.,

ACTING GOVERNMENT GEOLOGIST.

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GRAPHITE IN QUEENSLAND

WITH SPECIAL REFERENCE TO THE MOUNT BOPPLE GRAPHITE DEPOSITS.

INTRODUCTION.

The following notes have been prepared with the object of making available all that is at present known concerning the occurrence of graphite in Queensland. The principal deposits are at Mount Bopple, in the Maryborough district, where the graphite has been found sufficiently pure for commercial purposes, and where mines are now being worked with a view of supplying the demand which has been created for it.

Graphite occurs in other localities in Queensland, and in the following pages reference will be made to these and to the more important foreign sources of supply. Notes will also be given on the dressing, uses, values, and production of the mineral.

THE GRAPHITE DEPOSITS AT MOUNT BOPPLE.

POSITION, ETC.

The Mount Bopple graphite mines are situated on the range close to the North Coast Railway between Gympie and Maryborough, being about three miles south-east of Netherby, and about the same distance north-east of Gundiah. The highest point on the Bopple Range is Beacon Peak, 1,900 feet above sea-level, on which has been erected a trigonometrical staff. The peak, known as Mount Bopple, 1,800 feet high, is the most northerly one on the range, and is about three-quarters of a mile distant from the Beacon Peak.

The two peaks, together with Mount Gundiah, which is about a mile south of Beacon Peak, are connected by a low range having a north and south trend, and on both their eastern and western sides numerous steep and rugged spurs lead down to the flat country at their bases. It is on the spurs leading down from the gap between Mount Bopple and Beacon Peak that the graphite-bearing belt of country is situated. The position of this belt, together with other features, are shown on the accompanying plan. (Plate 1.)

GEOLOGICAL FEATURES.

Burrum coal measures are the prevailing sedimentary rocks around the Bopple Range, and their intrusion by igneous masses has resulted in the strata being much crumpled and faulted.

Mount Bopple, the northern peak, is made up of syenite, syenitic granite, and hornblende andesite, whilst Beacon Peak is composed of andesite and quartz felsite. The syenite is exposed on the western side of the saddle connecting Mount Bopple and Beacon Peak, and it also outcrops on the surface about 60 feet away from a shaft sunk by Mr. Simpson to prospect the graphite deposits on this side of the range. Granite and syenitic granite are exposed lower down the slope, and also further north on some of the spurs leading down from Mount Bopple.

Hornblende andesite is the predominating igneous rock on the eastern side of Mount Bopple, and in several places it is seen in contact with the coal measures. With other varieties of andesite it is also exposed in many localities to the north of the range in the direction of Tiaro, about four miles distant, and about a quarter of a mile west of Tiaro, in the banks of the Mary River, a natural section shows its association with coal measures. The intrusion of these igneous masses appear to have disturbed the sedimentary rocks throughout the district, and to have altered seams of bituminous coal to anthracite or graphite.

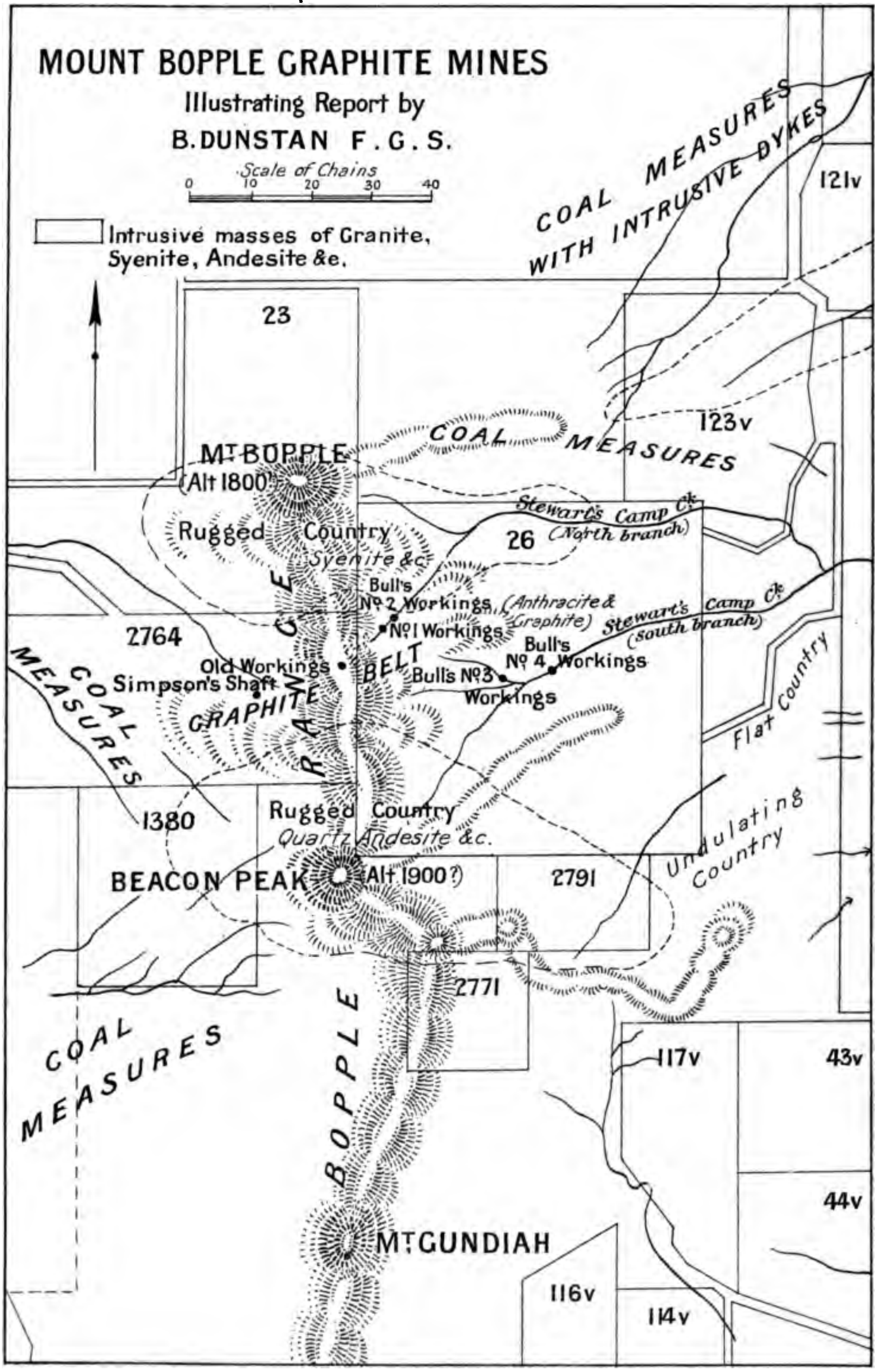
The occurrence of aplite was also observed at the graphite mines on the western slope of the range. At Simpson's shaft this rock is found in the graphite in the form of small veins about an inch in thickness, which taper out to leaders, and gradually change to a plumose mica. Occasionally the hornblende of the andesite is found in the form of black cleavable crystals about an inch in diameter, and, no doubt, the rumour that wolfram is found in this locality is due to the presence of this mineral.

The coal measures, containing bituminous coal seams, are exposed in the country all round the mountains, and at Tiaro, Gutchy Creek, Munna Creek, Kannighan Creek, and Redbank Creek outcrops are to be seen which show the strata to be undulating, with occasional areas in which all bedding structure have been destroyed.

Between Mount Bopple and Beacon Peak the coal measures are severely contorted, but an easterly and westerly trend can be distinguished, this direction being the axis of a folding movement which has taken place in the measures lying between the two mountains. This is illustrated on Plate 2, Fig. 2.

On the western slope of the Range the bituminous coal has been altered entirely to graphite, while on the eastern slopes the coal, by almost imperceptible stages, has been changed to semi-bituminous coal, anthracite, and graphite. In one locality the graphite rests on anthracite, with six inches of graphitic clay shale between, the beds of graphite, anthracite, shale, and associated rocks being quite uniform and apparently undisturbed. Sections of this are represented on Plate 3, Fig. 1, and Plate 2, Fig. 1. In the latter section the anthracite is divided into a large number of small bands interbedded with shale.

GEOLOGICAL SURVEY OF QUEENSLAND **PLATE I**



Illustrating Report on "Graphite in Queensland"

The anthracite is very lustrous and of good quality, but the bands are on an average only about an inch in thickness, whilst the bed of graphite, six inches above, is dull and earthy, and shows no perceptible division into bands of varying quality. The beds above and below are shales and sandstones, and there are no intrusive rocks in direct contact with either the graphite or anthracite. Probably the anthracite has been a coal of good quality, and that the graphite originally has been carbonaceous matter mixed with carbonate of iron. The intrusive masses of hornblende andesite in the vicinity might have induced the change from bituminous coal to anthracite at the same time that the carbon contained in the ironstone was changed into graphite. Subsequent leaching would have removed most of the iron, leaving a residue containing about 50 per cent. of graphitic carbon. Plate 3, Fig. 2, shows a section near Bull's graphite mines illustrating the intrusion of the graphite-bearing strata by dykes of hornblende andesite.

MINING OPERATIONS.

The work of exposing and developing the graphite deposits on the western slope of Mount Bopple are now proceeding at Simpson's mines, and a shaft has been sunk to prove the seams which are exposed on the surface.

The position of the shaft is shown on Plate 2, Fig. 1, the sections of the shaft and the seams being represented on Plate 4. At the first landing in the shaft (marked S. 1 on Plate 4, Fig. 1) a sample was stripped from a seam of graphite four feet thick, and which on analysis yielded 27·10 per cent. of carbon and 69·20 per cent. of ash. At the second landing (marked S. 2) a 3-foot seam of graphite was sampled, and was found to contain 32·28 per cent. of carbon and 62·40 per cent. of ash. Another sample was taken from a 2-foot seam at the third landing (S. 3) which yielded 18·32 per cent. of carbon and 76 per cent. of ash. Other samples were taken from positions lower down in the shaft, and gave results somewhat similar to the above. The whole of the analyses of the samples taken are tabulated on another page.

The seams which were sampled aggregate eleven feet of graphite, having an average composition of 25·59 per cent. of carbon and 69·30 per cent. of ash. Other bands of shale, aggregating 24 feet in thickness, contain a smaller percentage of graphite, while there is about ten feet of shale in which graphite is not present. Sections which have been exposed in the vicinity of the above workings show that other graphite seams are present interbedded with graphitic shales and sandstones, but their quality has not been ascertained.

The inclination of the strata in the upper portion of Simpson's shaft is at an angle of about 45°, but nearer the bottom the angle of dip is much steeper, and in one place is nearly vertical.

Some old workings, opened many years ago by Mr. C. S. A. Drain, are situated close to the gap between Mount Bopple and the Beacon

Peak. They show the graphite to be of the same general character as that exposed in the workings previously referred to, and they have the same alterations of graphite, graphitic shales, and graphitic sandstones. The rocks contain impressions of *Alethopteris australis* and *Phyllotheca*, and probably bear a close relation to the Burrum coal measures. Samples from the workings were obtained by Mr. W. H. Rands in 1890, who visited the locality when making a general examination of the geological features of the district.* A picked sample from here gave, on analysis, 6·3 per cent. of moisture and volatile hydrocarbons, 72·7 per cent. of carbon, and 21 per cent. of ash. Another sample taken from a number of bands in a section 36 feet wide yielded 7 per cent. of moisture and volatile hydrocarbons, 44·25 per cent. of carbon, and 48·75 per cent. of ash.

The workings at Bull's mines show that graphite occurs in several localities on the eastern slope of the range, but operations have been principally confined to four places. No. 1 Workings, situated in a ravine on one of the heads of the north branch of Stewart's Camp Creek, are in the vicinity of the line of contact of coal measures and an igneous rock mass. (*See* Plate 1.) The rocks consist of clay shales, sandy shales, and graphitic shales, and are much inclined. A seam of graphite, four inches thick, has been exposed in a short underlie shaft, and a sample taken from the face of the workings yielded, on analysis, 3·2 per cent. of moisture and volatile hydrocarbons, 16·3 per cent. of fixed carbon, and 78 per cent. of ash.

No. 2 Workings are in an adjoining watercourse, which also falls into the same branch of Stewart's Camp Creek. The sedimentary rocks here are shales, sandy shales, graphitic shales, and sandstones, together with a bed of graphite and a great number of bands of anthracite. Masses of hornblende andesite occur close to the workings, intrusions of which disturb the shales and sandstones and alter their character. The workings consist of a tunnel driven along the inclined seams of anthracite and graphite to a distance of 38 feet. A section of this tunnel is given on Plate 4, Fig. 1. The graphite from this tunnel contains 1·1 per cent. of moisture and volatile hydrocarbons, 74·1 per cent. of fixed carbon, and 24 per cent. of ash. A sample of the anthracite, picked from the bands which, altogether, make up about one-quarter of the whole of the five-foot seam, gave the following result:—

ANALYSIS OF ANTHRACITE BANDS, BULL'S MINE, MOUNT BOPPLE.

Moisture	1·2 per cent.
Vol. Hydrocarbons	3·3 ,,
Fixed Carbon	90·9 ,,
Ash	4·6 ,
	100·0 per cent.

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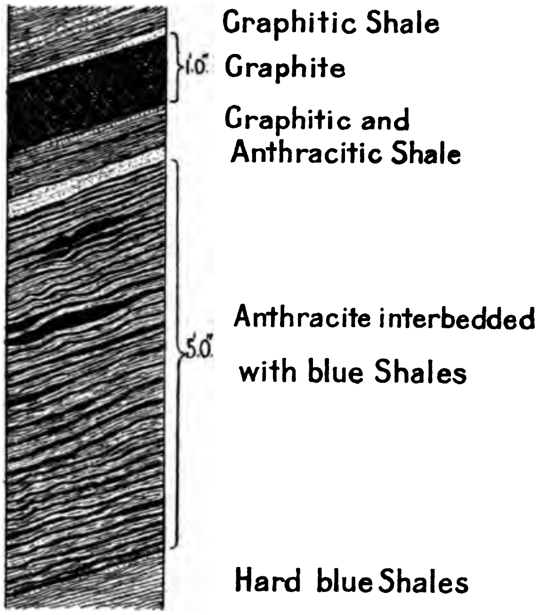
* Tiaro District: The Coal Measures, Neardie Antimony Mines, and Teebar and Culgoa Copper Mines, by W. H. Rands. By Auth.: Brisb., 1890, p. 8 G.S.Q.P., No. 59).

Sections at the Mount Bopple Graphite Mines

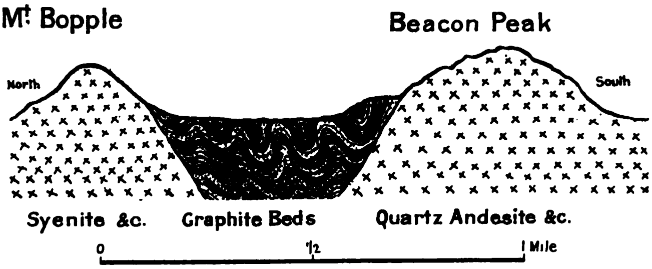
Fig. 1


Graphitic Shale
1.0'
Graphite
Graphitic and Anthracitic Shale
5.0'
Anthracite interbedded with blue Shales
Hard blue Shales

Section at Nº 2 Workings (Tunnel), Bull's Graphite Mine, Mt Bopple

Illustrating the occurrence of Anthracite with Graphite

Fig. 2



Section along the Bopple Range

Showing the crumpling of the Graphite-bearing Coal Measures between Mt Bopple and the Beacon Peak

Illustrating Report on "Graphite in Queensland

No. 3 Workings are situated on the south branch of Stewart's Camp Creek, at the position shown on the accompanying plan. (Plate 1.) They consist simply of some excavations in the bed of a watercourse in which seams of graphite occur interbedded with the shales. About three feet of the graphite-bearing shales have been exposed, but the surrounding features indicate the probability of other seams of graphite being found if a prospecting shaft were sunk close to the present workings.

At No. 4 Workings, which are lower down on the same watercourse, a four-foot seam of graphite has been exposed, and proves to be the largest of those discovered on the eastern side of the range. The cliffs in the vicinity show several small graphite seams interbedded with shales, and possibly others exist whose outcrops are covered by *débris*. A short tunnel has been driven into the four-foot graphite seam, a sample from which yielded, on analysis, 3·2 per cent. of moisture and volatile hydro-carbons, 16·3 per cent. of fixed carbon, and 78 per cent. of ash. A sketch section of No. 4 Workings is given on Plate 4, Fig. 2.

Other places in the vicinity of Bull's workings indicate the presence of several graphite deposits, and as there are here large areas known to be graphite-bearing, and many natural sections of rock exposed which have not been carefully examined, seams of better quality will probably be found as prospecting operations are advanced.

TABLE OF ANALYSES OF MOUNT BOPPLE GRAPHITE.

No.	Moisture and V. H. C.	Mixed Carbon.	Ash.	COMPOSITION OF ASH.			
				Silica.	Alumina.	Lime.	Alkalies, &c. (by difference).
1 ...	5·70	27·10	69·20	61·80	30·20	1·90	6·10
2 ...	5·32	32·28	62·40	58·30	35·80	1·70	4·20
3 ...	5·68	18·32	76·00	58·10	35·60	1·30	5·00
4 ...	4·46	22·14	73·40	55·60	37·20	2·70	4·50
5 ...	5·26	25·74	69·00	59·00	25·00	2·00	4·00
6 ...	5·22	27·98	66·80	59·80	35·10	1·40	3·70
7 ...	2·50	16·10	80·10	Ash is mainly Silicate of Alumina.			
8 ...	3·20	16·30	78·00				
9 ...	3·50	15·60	79·50				
10 ...	2·80	46·30	51·10				
11 ...	1·10	74·10	24·00				
12 ...	2·40	10·80	82·80				
13 ...	6·20	72·70	21·00				
14 ...	7·00	44·25	48·75				
15 ...	4·40	90·90	4·60				

NOTE.—A little iron and magnesia is present in all samples, but sulphur is absent

LOCALITIES FROM WHICH THE ABOVE SAMPLES WERE TAKEN.

No. 1. Simpson's shaft, No. 1 landing, 4-foot seam.

No. 2. Simpson's shaft, No. 2 landing, 3-foot seam.

No. 3. Simpson's shaft, No. 3 landing, 2-foot seam.

No. 4. Simpson's shaft, No. 4 landing, 1 foot 6 inch seam.

No. 5. Simpson's shaft, No. 5 landing, 6-inch seam.

No. 6. Simpson's shaft, sample from 6-ton parcel prepared for market.

No. 7. Bull's No. 4 Workings, sample from 6-ton parcel bagged for market.

No. 8. Bull's No. 4 Workings, from working face in short tunnel at No. 4 Workings.

No. 9. Bull's No. 3 Workings, from outcrop in watercourse (above No. 4 Workings).

No. 10. Bull's No. 1 Workings, from 4-inch seam in inclined tunnel.

No. 11. Bull's No. 2 Workings, from 1-foot seam in 38-foot tunnel.

No. 12. Bull's No. 2 Workings, from excavation in bed of watercourse.

No. 13. Drain's old workings, picked sample by Mr. Rands.*

No. 14. Drain's old workings, average sample from bands interbedded with shales, in a 36-foot section (by Mr. Rands).*

No. 15. Bull's No. 2 Workings, bands of anthracite below bed of graphite.

OTHER QUEENSLAND GRAPHITE DEPOSITS.

Mackay District.—The deposits of graphite in Selections 776 and 777, parish of Eton, was inspected in 1896 by Mr. A. Gibb Maitland, who furnished a report (unpublished) concerning their occurrence. He states that the graphite is associated with beds of shales and quartzites, traversed by what appears to be both interbedded and intrusive masses of igneous rocks.

In one locality on Scrubby Creek, the graphite has been exposed just above the level of the watercourse, and a prospecting tunnel has been driven into it for a distance of 80 feet. In thickness the "vein" averages about 18 inches, and has a perceptible dip to the north-east, while further along the bed of the gully the vein has a thickness of over four feet. About 20 tons of this graphite was bagged for experimental purposes, but the results of the trial have not been ascertained.

Another thin vein of graphite is exposed about eight feet above the one just referred to, but nothing has been done to determine its thickness or quality. Further up the course of the gully another mass of graphite associated with black shale is exposed, and is almost in contact with an intrusive rock. Nearer the head of the gully there are beds of shale exposed, which have been disturbed by these intrusions, whilst indications of the presence of graphite are to be noticed in several places near the same watercourse. In Palm-tree Gully, to the north of Scrubby Creek, graphite is to be found under similar conditions, and in several other localities outcrops of graphite and graphitic shales are also known.

The western side of Selection 777 consists of basalt with underlying shales, and the flanks of Homebush Hill, in Selection 776, are made up of horizontally-bedded shales with interbedded deposits of graphite, none of which, however, have been examined.

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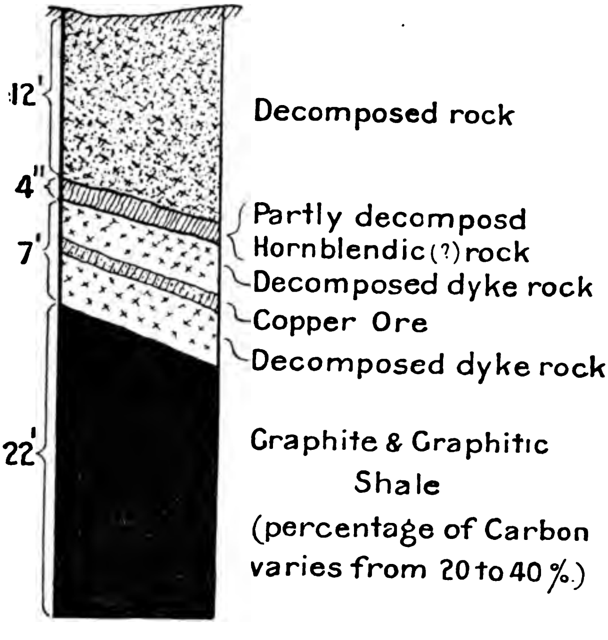
* *Loc. cit.* (G.S.Q.P. No. 59), p. 4.

The graphite from the localities in this district, according to Mr. Maitland, contains from 15 to 70 per cent. of graphitic carbon, and at the time he made the examination considered the deposits to be worth further attention.

CLONCURRY.—Graphite was discovered near Cloncurry in 1880,* but for many years no further exploration has been made of it. Quite recently, however, samples of graphite have been received from Hampden, near Cloncurry, where a large deposit exists. Most of the material is of an inferior quality, but some portions contain 40 per cent. of carbon. A shaft sunk to prospect for copper penetrated a large mass of graphite of unknown dimensions, of which Mr. Jas. Long furnishes the following section:—

Section of Graphite Deposit, Hampden.



STANTHORPE DISTRICT.—Graphitic slate is present in the Silver Spur Mine at Texas,† but its quality does not warrant any consideration being given to it as a commercial product. At Wilson's Downfall, on the New South Wales border, graphite occurs in abundance; but up to the present the deposits which have been found have proved to be inferior in quality. Much requires to be done, however, before any definite conclusion can be arrived at as to their value.

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* Annual Report of the Department of Mines for 1880, p. 31.

† Notes on Tin, Copper, and Silver, in the Stanthorpe District, by L.C.B. By Auth.: Brisb., 1904, p. 31 (G.S.Q.P., No. 191).

CAPE UPSTART.*—Deposits of graphite are known at Cape Upstart, on the coast between Townsville and Bowen, but they have not been developed to any extent. Prospecting operations which are now in progress show that the seam of graphite varies from four to eight feet thick, and is in coal measures close to a mass of igneous rock. The quality appears to be similar to that of the graphite at Mount Bopple.

GYMPIE.—Graphite is intimately associated with the reefs which traverse the slates of this goldfield. The quality is very poor, and of no commercial value.

CROYDON.—The granitic and felsitic rocks prevailing on this goldfield contain small quantities of graphite.† In the granite it is found as irregular inclusions, and is much contaminated with clay. In the felsites it is in the form of flakes, very pure in quality, but finely disseminated.

HAMILTON GOLDFIELD.—The quartzites associated with the reefs on this goldfield contain a quantity of graphite in the form of flakes.‡

NORMANBY GOLDFIELD (Reid's Creek).—A large deposit of graphite has been found on Rosslyn Run, near Greenbank, but no authentic information has been obtained concerning its quality.§

YORKEY'S GOLDFIELD.—In Campbell's reef on this field graphite is associated with pyrites and quartz.

NEW GUINEA.—"The presence of graphite or plumbago has been demonstrated over nearly the whole of the known portion of the Possession, but always as an accessory constituent of the schists; in some cases it occurs in such a quantity as to give a distinctive character to the rocks. In the most graphitic of the schists, although the quantity is proportionally large, to remove the impurities (chiefly quartz) by washing or other means would be too costly to be remunerative."||

NOTES ON GRAPHITE IN NEW SOUTH WALES.

A deposit of graphite-bearing shale is exposed near Underwood Station, about twelve miles from Wilson's Downfall, near the Queensland border. It is interbedded with sedimentary rocks which have been altered by an intrusive mass of granite. A trial has been made of the graphite by the Springfield Facing Company, Massa-

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* Mineral Wealth of Queensland, by R.L.J. Brisb.: By Auth. 1888, p. 67 (G.S.Q.P., No. 48).

† Some Croydon Gold Mines, by B.D. Brisb.: By Auth., 1905, pp. 9-10 (G.S.Q.P., No. 202).

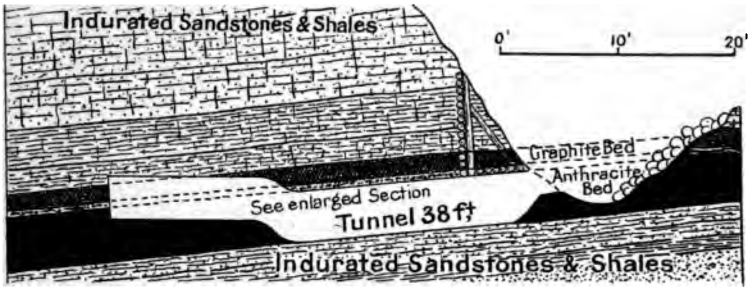
‡ The Hamilton and Coen Goldfield, by L. C. Ball. Brisb.: By Auth., 1901, p. 4 (G.S.Q.P., No. 163).

§ Annual Report of the Department of Mines, 1887. Brisb.: By Auth., 1888, p. 54.

|| Geological Observations in British New Guinea, by A. Gibb Maitland. Brisb.: By Auth., 1892, p. 32 (G.S.Q.P., No. 85).

Sections at the Mt. Bopple Graphite Mines

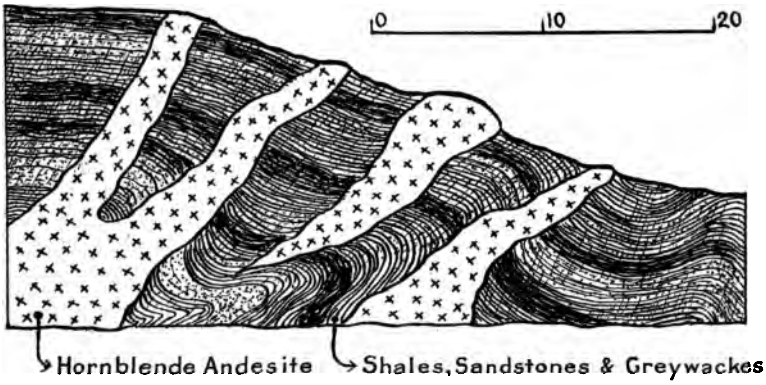
Fig. 1



Section of No. 2 Workings Bull's Mine

Showing the position of the beds of Sandstones, Shales, Graphite and Anthracite

Fig. 2



Section near Bull's Graphite Mines

Showing the intrusion of the Graphite-bearing beds with Hornblende Andesite

Illustrating Report on "Graphite in Queensland"

chusetts, and the following report was furnished:—"We are positive that it would make a very good facing, and could be used to advantage wherever German "lead" (plumbago) is used in the manufacture of foundry facings. It is true that it would probably be impossible to ship it to this country at the price we pay you, as we can buy a powdered German lead at 1¼ cents in New York, or an Italian lead, which closely resembles it, at about 16 dollars per ton. On any work in the foundry where the facing is used wet—such as dry sand or cores—it would be a very good article indeed, and in any market you could reach we think it would pay to have same used."—(Min. Resources of N.S.W., by E. F. Pittman.)

In New South Wales deposits of graphite are also known to occur at Grafton, Mudgee, Fairfield, Hillgrove, Tobin's Creek, Cowell Creek, near Port Macquarie, Dundee, Tenterfield, Pambula, Cordeaux River, Plumbago Creek in the county of Drake, and at the head of the Abercrombie River.

NOTES ON SOME BRITISH AND FOREIGN GRAPHITES.

With the occurrence of so many deposits in Queensland, and so many possibilities of finding a higher grade graphite than that already known, some information concerning foreign deposits might prove useful. There are some discrepancies and apparent inconsistencies in the data given below, but no means are available for checking the accuracy of the varying statements made in the works consulted, so the information can be taken for what it is worth.

Ceylon.—The mines of Ceylon are the largest in the world, and the graphite produced is of such high quality that it may be taken as the market standard. An average analysis of high-grade Ceylon graphite is as follows:—

CEYLON HIGH-GRADE GRAPHITE.

Volatile matter	0·310 per cent.
Carbon	98·284 ,,
Ash	0·415 ,,

The country rock is granite, gneiss, &c., partly decomposed, in which the graphite, in the form of coarsely foliated masses, occurs in true fissure veins.

Italy.—The mines at Pinerolo district of Piedmont produces a graphite containing from 10 to 80 per cent. of carbon. The raw material, after grinding, contains, on an average, about 61 per cent. of pure graphite.

Bavaria.—At the Passau mines the graphite occurs as an impregnation of gneissic rocks, and is closely associated with beds of limestone. The graphite is of poor quality, the best undressed material containing 53·8 per cent. of carbon, the inferior 31·72 per cent. The dressed article contains 89·2 per cent. of carbon, and the waste material from 22·3 to 36·8 per cent.

CUMBERLAND, ENGLAND.—The old Borrowdale graphite mines have been practically idle for the last forty years, and are exhausted. The graphite is in the form of nests and lumps, and occurs in veins of quartz and calcite which traverse greenstone porphyry. The graphite produced from these mines was a fine flake variety, used principally in the manufacture of lead pencils.

BUCKINGHAM, QUEBEC.—In these Canadian mines the graphite is disseminated in gneiss, &c., the deposits varying in thickness from a few feet to 25 feet. The proportion of graphite to rock is from 10 to 50 per cent., but in one particular bed, 20 feet in thickness, the average yield is 20 per cent. of graphite. The raw graphite has the following average composition, and considerable quantities of this rock has been mined:—

ANALYSES OF BUCKINGHAM GRAPHITE.

Hygroscopic moisture	1·740 per cent.
Soluble in HCl	19·467 ,,
Insoluble	56·408 ,,
Carbon	22·385 ,,

ONTARIO.—Considerable quantities of graphite are obtained at the mines at Renfrew, but it is stated that the industry is only carried on profitably when the percentage of graphite in the gangue is more than 15 per cent. At the Black Donald Mine the total amount of graphite in the product is about 65 per cent., of which about 45 per cent. is amorphous, the remainder being the flake variety. Some portions of the deposit yield a graphite containing as much as 80 per cent. of carbon, whilst low-grade portions contain about 25 per cent. of carbon. The graphite occurs as a vein in crystalline limestone, and is associated with seams and pockets of chlorite, and is close to schistose rocks.

At the McConnell Mine, near Perth, Lanark County, the product, which is in a flake form, contains much less carbon than that at the Black Donald Mine. The country rock is limestone, and the graphite occurs in zones or veins several hundred feet long.

BOHEMIA.—The Schwarzbach-Kruman deposits are lenticular in shape, and are associated with limestones. The graphite is much desired for pencils, and in being compact and without foliation is admirably suited for this purpose. The refined graphite contains from 50 to 60 per cent. of carbon.

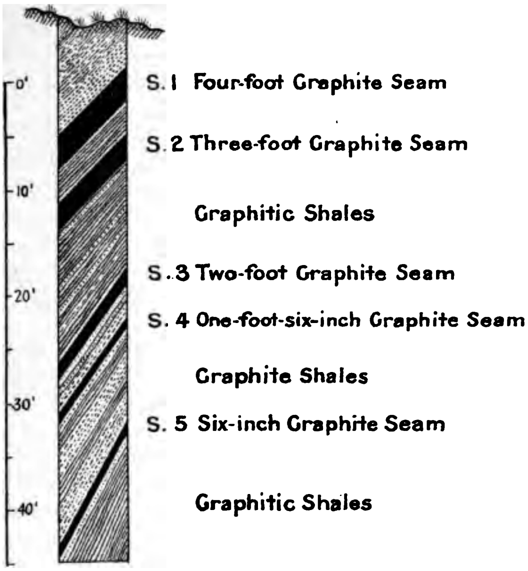
STYRIA.—The deposits in this locality are associated with strata belonging to coal measures. The graphite produced contains from 73·8 to 88·5 per cent. of carbon, and analyses show it to have the following average composition:—

ANALYSES OF STYRIAN GRAPHITE.

Alumina	6·12 per cent.
Silica	13·04 ,,
Carbon	77·95 ,,

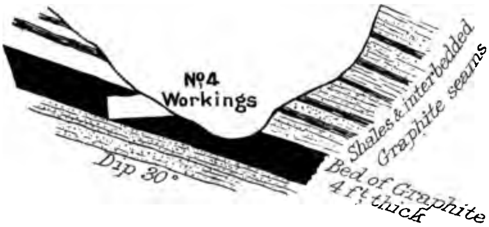
Sections at the Mount Bopple Graphite Mines

Fig. I


0'
10'
20'
30'
40'
S. 1 Four-foot Graphite Seam
S. 2 Three-foot Graphite Seam
Graphitic Shales
S. 3 Two-foot Graphite Seam
S. 4 One-foot-six-inch Graphite Seam
Graphite Shales
S. 5 Six-inch Graphite Seam
Graphitic Shales

Section of Shaft at Simpson's Mine
Showing the position of the Graphite Seams
(See accompanying table for analysis)

Fig. 2


No. 4 Workings
Shales & interbedded Graphite seams
Bed of Graphite 4 ft thick
Dip 30°

Section across the South Branch of Stewart's Camp Creek
Showing No. 4 Graphite Workings at Bull's Mine

Illustrating Report on "Graphite in Queensland"

As the silica is the principal impurity, the graphite is very refractory, and in consequence is in great demand for the manufacture of crucibles.

Irkutsk, Siberia.—At the Batugol mines the graphite is of very fine quality, and much used in pencil-making. It occurs as fibrous lumps in veins traversing granite and diorite, and is closely associated with an altered limestone.

Ticonderoga, New York.—The mines at this locality are worked by Dixon, and are the principal source of supply in the United States. The rock as mined averages ten per cent. of graphite, but deposits are said to be worked which yield not more than six per cent. These deposits are stated to be "elliptical chimneys in gneiss, which have been filled with calcite and graphite."

Austria.—The Northern Moravian mines produce a graphite containing 53 per cent. of carbon, and 44 per cent. of ash.

South Dakota.—The graphite found at Rockford, in this State, contains from 26 to 41 per cent. of carbon, which, without being accompanied by other higher grades, is considered too low in quality to profitably mine.

Mexico.—Mexican graphite varies from 40 to 50 per cent. in carbon contents.

Corona, U.S.A.—"Corona" graphite contains 57 per cent. of carbon and about 40 per cent. of ash. It is the material now being used by the Southern Pacific Railway Company for paint, fine lubrication, foundry facings, and hot-box grease.

India.—Samples have been submitted to the Imperial Institute from the Chatisgarh district, and were found to contain respectively 40·95, 37, 79·91, 69·67, 63·70, and 54·73 per cent. of fixed carbon. The sample containing 79·91 per cent. of carbon was not considered sufficiently pure to be used in the making of crucibles, and could only be utilised for stove-polishing and similar purposes, and would be worth about £10 per ton. The remaining samples, except that containing 69·67 per cent. of carbon, were said to be of very little value. It is further stated that the supply of graphite having less than 85 per cent. of carbon was very much in excess of the demand, and that in consequence such quality could only command a low price.

ARTIFICIAL GRAPHITE.

Artificial graphite is manufactured by the International Acheson Graphitic Company, Niagara Falls, New York, U.S.A. The method of its manufacture was discovered by Mr. Acheson while developing some experiments in the making of carborundum, a substance having a hardness greater than emery, and now used extensively as an abrasive.

The silicon which is combined with the carbon in carborundum is vaporised at a very high temperature, and the carbon, in the form of graphite, remains as an infusible residue. Additional experiments showed that anthracite coal can be converted into graphite.

In conducting the operations of converting anthracite into graphite, the anthracite is heated for a number of hours in an electric furnace with an expenditure of energy equivalent to 1,000-h.p. "The furnace consists of a long narrow trough made of fire brick, and lined with some suitable refractory material. At each end of the trough there is a terminal, built of large carbon rods to which are connected the cables conveying the current. The trough is filled with anthracite coal in which is bedded carbon rods to make electrical connection between the terminals. The temperature is raised to a point where the carbon is first converted into carbides of the various constituents of the ash, which in anthracite coal is very evenly distributed throughout the mass, and is then carried still higher to a point at which the carbides are decomposed, the principal constituents of the original ash, silicon, iron, and aluminium being driven off as vapours."

"The residue removed from the furnace is carbon in the form of graphite, perfectly free from any trace of amorphous carbon. The purity of the graphite depends on the temperature to which it has been raised, and for commercial purposes it is found sufficient to keep the ash contents below ten per cent. When reduced to this percentage the ash still remaining in the graphite is practically as inert as the graphite itself. When removed from the furnace the graphite is ground up and the grades suitable for various purposes separated."—(Pamp.—Acheson Co.)

CONCENTRATING AND DRESSING GRAPHITE.

The means employed in dressing the graphite for market comprise operations in crushing, screening, air jigging, and sizing, and the operations at the Black Donald and McConnell mines, previously referred to, may be taken as examples.

At the McConnell Mine the operation is as follows:—"After coarse crushing and drying, the ore is reduced to a fine size and screened several times to remove a considerable proportion of the limestone gangue as dust. A cleaner separation of the intermixed rock is effected by concentrating in pneumatic jigs, and the concentrates are then ground in a series of millstones. The polished and enriched flake discharged from the last stone undergoes wet buddling in small vats, which finish the work of concentration, after which the graphite is again dried, preparatory to the final grading in revolving screens into two or, when desired, more sizes, the coarsest being from fifteen to twenty mesh size. On account of the low content of carbon in the crude ore, this elaborate scheme of concentration has been adopted in order that the saving should be as high as possible. The flake product is of high grade suitable for crucible stock. The capacity of the McConnell refinery is from 15 to 20 tons of ore per day."—("Min. Industry," 1902.)

The Black Donald refinery has a capacity of 15 tons per day, and uses a wet process of concentration with large buddles. "All of the material but the tails is dried either in an electric-heated or ordinary fire-heated revolving cylinder, sized, and then ground between millstones, which pulverise the gangue and amorphous graphite and merely polish the flake. After grinding, the product is passed through a series of revolving screens of gradually decreasing mesh, by which four sizes of flake are separated out, then a mixed flake and amorphous grade, and finally four or more sizes of amorphous graphite. The first flake is the coarsest and cleanest product, running about ten-mesh size and 96 per cent. C.; the remaining grades of flake decrease in size, but all are over 90 per cent. pure. The amorphous grades are in powder form and carry from 54 to 62 per cent. C. The limestone remaining with the graphite after buddling pulverises more readily than the graphite, and in the screening separates out from the graphite as dust."

"This mine is exceptional, both as regards uniformity and quality of the graphite, and size of the deposit. Since the erection of the refinery practically all the ore may be converted into valuable products, chief of which are the grades of flake for use in the manufacture of crucibles."—(Mineral Products, 1902.)

In the "Mineral Resources" for 1902, p. 976, it is stated that "there are two methods of concentrating graphite from its ore, the wet and the dry. No mill has adopted the dry or air method in its entirety, on account of the gravities of the component parts of the ore being so close to one another. Several pneumatic processes have lately proved a partial success, but they have been of limited application on account of the inability to remove the small scales of mica which occur in some of the deposits. The wet or water method of concentration has been developed to a marked degree of efficiency, and is the one now used by the operative companies (*sic*). The general method of procedure is to crush the ore, stamp it wet, separate coarsely by stationary buddles, the concentrates being dried and further treated with buhrstones and screens."

At the Buckingham mines the mill has a capacity of 20 tons per day, treats 25 per cent. ore, and gives daily about three tons of a finished product, which contain 60 per cent. of graphite. The ore, after crushing and drying, is treated on a Brumell separator, a machine designed to clean the graphite by floating it on the surface of water.

A process of treating the graphite consists in grinding the ore, and then passing it through sieves having from 120 to 150 meshes to the inch, afterwards adding steatite and alum. The average composition of this mixture would be eighty parts of graphite, fourteen parts of steatite, and six parts of alum, but this is subject to variation according to requirements. It is said that a graphite thus treated will bind together, which, before treatment, will not do so, and that a graphite which will only bind to a limited degree is much improved by the treatment.

Finely-powdered graphite, after washing, is sometimes purified by mixing fourteen parts of it with one part of potassium chlorate and two parts of 66° sulphuric acid, heating on a water bath for some hours, and then washing again and roasting to a red heat. This removes most of the substances which cannot be removed in the ordinary washing processes. Silica, if present, and if desirable to remove, necessitates supplementary treatment with hydrofluoric acid.

In the Mount Bopple graphites, the amorphous condition of the carbon, and the presence of the silica and clay in a fine state of division, suggests that a difficulty would be experienced in treating it by any method of mechanical concentration, and that in consequence hand-picking would have to be relied on to grade it up to a marketable quality.

USES OF GRAPHITE.

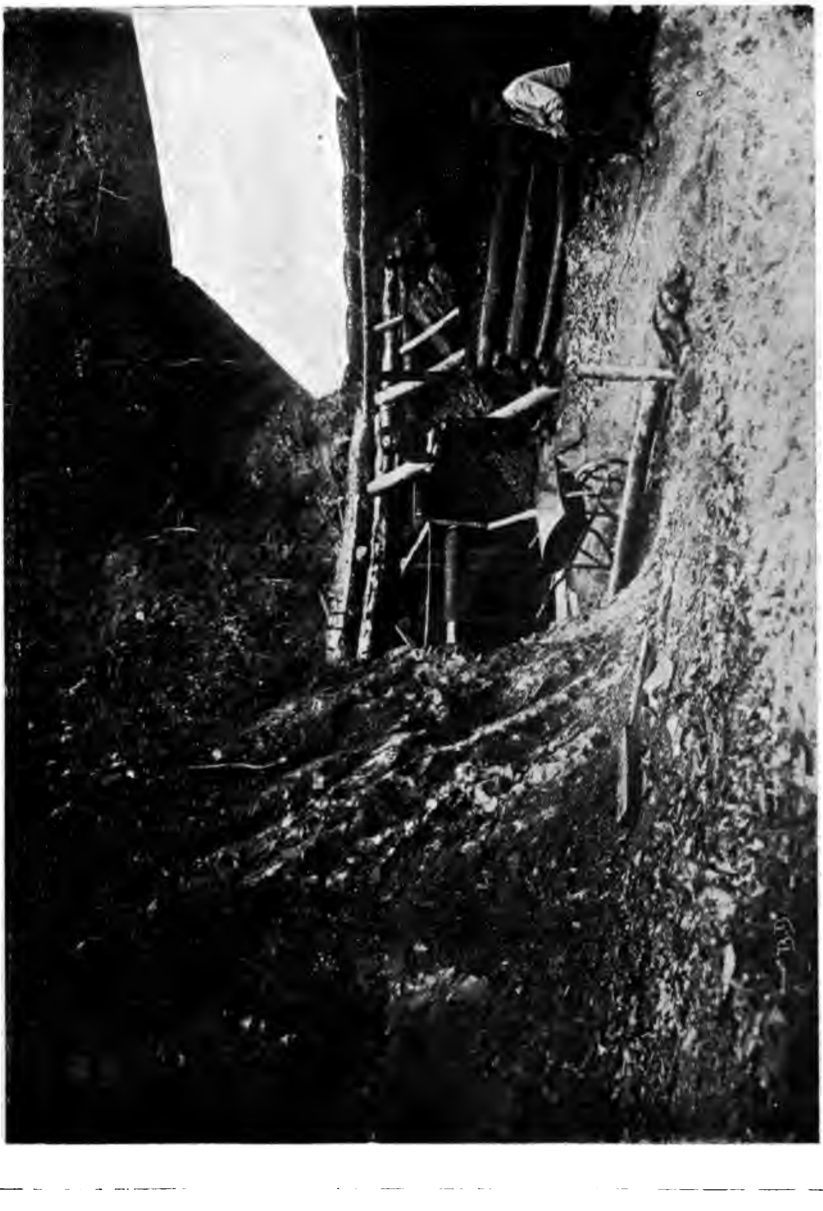
Graphite is used in the manufacture of crucibles, stove polish, foundry facings, paints, pencils, steam-packing, dry batteries, and in electrotyping and chemical operations.

Lubricants require a high-grade flake graphite, none but the very best material being used for this purpose. Many processes have been devised for utilising the graphite in this way, but the most recent method, which gives promise of being successful, consists in saturating the powdered graphite with oil, and then suspending it in another oil which will not mix with that used in the saturation of the graphite. Mixed with grease, the graphite forms, ordinarily, a lubricant for journals, but the new method of preparation with oil will enable it to be used extensively in the lubrication of cylinders. Mixed with an equal proportion of grease, the graphite is used as a hot-box "cooler."

In the manufacture of crucibles, the flake form is required, and usually a very high-grade quality is indispensable. The flake variety has a tendency to bind together when worked up into articles, whilst the amorphous kind has not this property. Intermediate qualities, in having some of the properties of flake graphite, may be used in the manufacture of crucibles, but they will not stand more than one heating, and have to be crushed and moulded again. When the material of which the pots are made is too coarse, the pots are found to be porous, and if too fine, they are very liable to crack. Graphite which has only a slight binding property may be improved by treating with alum, &c., in the manner mentioned above.

Crucibles of good quality (as manufactured by Dixon) contain 50 per cent. of carbon, 33 per cent. of clay, and 14 per cent. of sand, but it is necessary to first obtain the graphite very pure and mix the

GEOLOGICAL SURVEY OF QUEENSLAND. PLATE 5.



SIMPSON'S GRAPHITE MINE, MOUNT BOPPLE
(NEAR THE NETHERBY RAILWAY STATION).

substances with it afterwards. Raw graphite cannot, as a rule, be used for this purpose on account of the impurities it contains, although in the case of the Styria graphite referred to, the composition of the raw article shows that none of the silica and alumina would require to be removed as impurities, and that it would only be necessary to add sufficient clay and silica to make up the proportion required of those ingredients in the manufacture of crucibles.

"The material for making crucibles is sieved through screens containing from 40 to 100 meshes to the inch. The clay should be refractory, and the sand is passed through a forty-mesh screen. The clay is made into a thin paste with water, and sand and graphite are mixed in, and the dough is then passed several times through a pug-mill, after which it is tempered for several weeks in a damp place. Weighed lumps of the tempered dough are then kneaded and moulded on a wheel, which is considered to be better than simple pressing, as the graphite flakes are arranged tangentially and bind the mass better. The crucibles are placed in plaster moulds and left for three hours, during which time the plaster absorbs part of the moisture; they are then dried for a week at a temperature of 70° to 80° Fahr., and burned in a common pottery kiln, which is first fired with anthracite coal and afterwards with long-flaming wood. The burning takes a week, the temperature reaching about 1,350° C."—("Min. Industry," Vol. 2 (1893), p. 341.)

Stove polish, foundry facings, and electrotyping requires a low-grade graphite, and the amorphous variety is principally used for such purposes. In Canada the graphite used for foundry facings is only considered good when it contains 50 per cent. of carbon.

Pencils are made from "flakeless" graphite, but for this purpose the material must be very fine in grain and of the purest quality. The Batugol mines at Irkutsk, in Siberia, are said to produce a very fine quality of graphite for lead pencils.

Its use as moulds in metal-casting is also recommended as a substitute for iron, and is supposed to have some property which makes it specially suitable for this work. As a substitute for white and red lead it is stated to give great satisfaction, and in using it as a cement for pipe joints the iron is said to remain clean, even though the faces are exposed for a considerable time to the action of steam.

Graphite is very extensively employed in the composition of paints, some manufacturers using a low-grade article, while others consider that a high-grade graphite is more suitable. The paints on the market made from various natural graphites contain 50 per cent. or less of graphite, the other portion being made up of silica, oil, &c. It seems, however, that the manufacturer requires a graphite of good quality to operate upon, and would not think of using a natural graphite unless it contained considerably more than 50 per cent. of carbon.

The consumption of graphite for the various uses to which it is applied is tabulated below, from which it is seen that crucibles absorb more than half the whole of the production:—

Crucibles	55 per cent.
Stove polish	15 ,,
Foundry facings	10 ,,
Paints	5 ,,
Other uses	15 ,,
	100 per cent

GRAPHITE PRODUCTION AND VALUES.

In Australia the imports and production of graphite (which is also classed under plumbago and black lead) are not definitely known, but the following returns are furnished from all the statistical references available:—

VICTORIA.—Imported 555 tons during the four years, 1899 to 1902 (value £5,543, or about £10 per ton).

NEW SOUTH WALES.—Imports (no returns). Produced in 1894 16 tons, valued at £68; and in 1896, 80 tons, valued at £160.

QUEENSLAND.—Imported 113 tons during the six years, 1899 to 1904, value £3,154 (or about £26 10s. per ton).

SOUTH AUSTRALIA.—Imported 19 tons during the year 1903, value £294 (or about £15 9s. per ton).

TASMANIA.—Imported 8 tons* during the two years, 1901 and 1903, value £212 (or about £26 10s. per ton).

WESTERN AUSTRALIA.—The value of the imports during 1901 was £46.

The United States consumes almost all the natural graphite produced in that country, and with England absorbs about 80 per cent. of the whole of the higher grades produced in all parts of the world.

The production of graphite in the United States, during the year 1902, amounted to (*a*) 2,000 tons of refined graphite, valued at £20 per ton; (*b*) nearly 4,700 tons of amorphous graphite, valued at £2 15s. per ton; and (*c*) over 1,000 tons of artificial graphite, valued at £22 10s. per ton.

From this an opinion may be formed of the value of Queensland graphite as an article of export. At all the localities in Queensland where graphite exists in quantity, only the amorphous variety has been found, and this could not be expected to realise more than the prices quoted for the same variety in the United States. In England the same prices prevail.

As an article of trade within the Commonwealth however, it has decidedly an advantage over the imported graphite of the same class, and the demand for it in connection with foundry work will certainly increase when once those who are using the imported article can be persuaded to give the Queensland product a trial.

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* Estimated.

By Authority: GEORGE ARTHUR VAUGHAN, Government Printer, William street, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY REPORT
No. 200.

The Central Queensland (Dawson-Mackenzie) Coal Measures.

THEIR CONTINUATION TOWARDS THE MACKAY AND NEBO DISTRICTS.

(WITH MAP.)

BY

WALTER E. CAMERON, B.A. (Cantab.)
ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

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THEIR CONTINUATION TOWARDS THE MACKAY AND NEBO DISTRICTS.

◆

I.—INTRODUCTION.

The field work for this report occupied the months of May, June, and July of last year. It took the form of a rapid geological reconnaisance of the country drained by the Isaacs River and Funnel Creek and their tributaries, its object being to trace the continuation of the coal measures, at present being prospected along the Central District railway line, northwards, towards those known to exist in the Nebo and Mackay districts, and to map the relations between the two.

The coal beds of the Nebo district had been previously referred to in geological reports both by R. L. Jack* and A. Gibb Maitland†, and their identity with those along the Central line inferred on palaeontological grounds, but the intervening country had never been examined by an officer of the Survey, and the mapping of the beds on the Colony Geological Map was only a guess at the relation between the two districts.

The general geological features of the Permo-Carboniferous coal measures of the Central District had not been in any way elucidated until the district along the Central line was mapped and described by Mr. Dunstan in 1901. Mr. Dunstan's examination extended in a north and south direction along the eastern boundary of the coal measures from a point on the Dawson River some 80 miles south of the line northwards across the line, and for another 60 miles up the Mackenzie River to near its junction with the Isaacs.

In a westerly direction the beds were mapped along the Central Railway for a distance of about 80 miles from their eastermost outcrops.

The results of this survey were published in a report entitled "The Geology of the Dawson River, with special reference to the occurrence of Anthracite Coal," published as No. 155 of the Geological Survey Publications. The map accompanying the report shows the extent of the area examined and the general disposition of the beds.

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* Geological Features of the Mackay District. R. L. Jack. Brisb.: By Auth., 1887. (G.S.Q., P. No. 39.)

† Geological Observations at the heads of the Isaacs, Suttor, and Bowen Rivers. A.G.M. Brisb.: By Auth., 1889. (G.S.Q., P. No. 54.)

In his report on the Mackay district Mr. Jack made the first reference to the discovery of coal of a semi-anthracitic character in Queensland, and published an analysis showing its percentage composition. The analysis is given later on in this report. The coal came from Walker's Creek, about 60 miles south-west of the port of Mackay, and about 10 miles due west of Nebo. The work done by the writer shows that the beds containing this coal are a continuation of those in which high-steaming coals were subsequently found on the Dawson, and traced by Mr. Dunstan to the junction of the Isaacs and Mackenzie River, and consequently shows that the coal resources of Central Queensland are continuous for many miles north of the Mackenzie River. It has also served to define the eastern boundaries of the coal measures, with some attempt at accuracy, for some distance further north than formerly, besides throwing additional light on the general disposition of the beds.

Since 1901, when the first coal seam was discovered in the Dawson-Mackenzie Valley, about 40 miles south of the Central line, prospecting for coal has been carried on by several companies, with the object of locating seams along the railway line. This has resulted in the finding of coal at several places in close proximity to the line, notably at Wallaroo, about 78 miles west of Rockhampton, and also near Blackwater, 108 miles from Rockhampton. The high steaming qualities of these coals, as shown by several tests made by the engineers of H.M. warships, has led to the hope that in the near future Central Queensland will become a large exporter of steam coal.

The fact that coals of high steaming character have been found at such widely separated points (Walker Creek being some 220 miles from the coal beds on the Dawson), and that the beds are continuous between the two places, gives a promising forecast for the great resources of this portion of Queensland in high-class steaming coal.

The accompanying map shows, in as much detail as the time occupied in the journey would allow, the continuation of the lower beds of the coal measures. These outcrop along the eastern margin of the field and were traced from near the junction of the Isaacs and Mackenzie Rivers to the head waters of Cooper Creek, near Mount Britten Goldfield, a distance of about 120 miles. The mapping was greatly facilitated, and rendered more accurate, by the use of an advance copy of a sheet of the four miles maps of unsettled districts, at present being issued by the Lands Department, which was then being prepared for issue, and was kindly supplied by the department. A few additions to the topographical detail have been made wherever they were observed, especially in the matter of roads which have sprung into existence since the survey of the country. A few corrections have also been made in place names where they have recently been changed.

II.—GENERAL GEOLOGY OF THE COAL MEASURES OF CENTRAL QUEENSLAND.

The coal-bearing beds at the head of the Isaacs, and those examined by Mr. Dunstan along the Central Railway line, are shown by the assemblage of fossils found in them to be both of Permo-Carboniferous age, and thus of the same age as the coal measures of Newcastle, Bulli, and Lithgow, in New South Wales. They are thus older than the coal measures hitherto worked in Queensland at Ipswich and Burrum, which belong to the Trias-Jura system. They are, however, of the same age as the coal beds of the Bowen River, lying still further to the north. These latter beds were tested by Government bores as long ago as 1879, and shown to contain several valuable seams of coal. They were reported on in the same year by R. L. Jack*, late Government Geologist; and from them the whole of the coal beds of Central Queensland, from the Bowen River on the north to the heads of the Dawson on the south, and for a width of about 120 miles in an east and west direction, have long been known as the Bowen River beds. They are shown on the Colony Geological Map underlying an area of about 37,000 square miles, occupying the greater portion of the valleys of the Dawson, Mackenzie, and Isaacs Rivers. Their eastern margin has been roughly mapped in by Mr. Dunstan and the author along the western flanks of the ranges which hedge in the valleys of these rivers from the lower coastal country. Their western and southern boundaries, however, have only been roughly guessed at. Along their eastern margin they are underlain by considerably altered quartzites, slates, and schists, which have proved fossiliferous in a few areas close to the Central line, and which have there been referred to the Gympie formation. North of the Isaacs-Mackenzie junction similar altered sedimentary rocks are found to the east of the coal measures, but so far they have not proved fossiliferous. Their highly-developed cleavages and frequent intrusions of igneous rocks stand out in marked contrast to the comparatively unaltered character of the beds in which the coal measures lie. As the Nebo district is approached the intrusive plutonic rocks become more prevalent, till they culminate in the Eungella Ranges, at the back of Mackay, as a belt of granite and diorite some 20 miles in width.

Mr. Dunstan, in his report, divided the Bowen River beds in the Central district into an Upper and a Lower Formation, with an unconformity between the two. The Lower Formation he divides into four series, all conformable with each other, but distinguished by palaeontological features from each other. They are as follow:—

1. Upper Freshwater Series, with glossopteris and other plant remains.
2. Upper Marine Series, with marine fossils.
3. Lower Freshwater Series, with glossopteris.
4. Lower Marine Series, with marine fossils.

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* On the Bowen River Coal Fields. R.L.J. Brisb.: By Auth., 1879. (G.S.Q., P. No. 4.)

The Lower Marine Series thus forms the lowest division of the Lower Bowen Formation, as developed in the Central District. In the Bowen River district, where the Permo-Carboniferous coal measures were first examined in detail, Mr. Jack divided the Bowen River beds into a Lower, Middle, and Upper Formation, as follow:—

1. Upper Formation (Freshwater coal-bearing series).
2. Middle Formation (Marine beds, with productive crinoid, &c.)
3. Lower Formation (conglomerates, volcanic agglomerates, unfossiliferous sandstones, with interbedded porphyries and basalts.

The Lower Marine Series of Mr. Dunstan was traced by the writer from the northernmost point of Mr. Dunstan's map as far as the Yatton Goldfield, and was found again over a length of some 10 miles near Mount Britten and Eungella. It was traced by Maitland from here to R. L. Jack's Middle or Marine Formation on the Bowen River.* The Lower Freshwater series of the Central district was found overlying the marine beds along the Isaacs Valley to near its source, and is no doubt continuous with Jack's Upper or Freshwater Formation. The new classification proposed by Mr. Dunstan accordingly places Mr. Jack's Middle Formation (Marine) on the same horizon as the Lower Marine series of the Central District, and his Upper or Freshwater Formation on the same horizon as the Lower Freshwater series, including them both in the Lower Formation, and extending that formation up to include conformably overlying Marine and Freshwater series above. Succeeding this Lower Formation of alternating Marine and freshwater series unconformably, are the beds of the Upper Formation, which have as yet been found only over small areas in the Clermont coal fields and at Tolmie's, on the Central line.

The beds of the Lower Bowen Formation over the greater portion of the Dawson-Mackenzie Valley are overlain by newer Lower Cretaceous and recent formations. The lowest beds of the formation—the Lower Marine series—come to the surface along the eastern border of the Dawson-Mackenzie Valley as an outcrop of sandstones and limestones, some four miles in width, running in a north and south direction along the western flanks of the range, which hems in the eastern side of the valley. This outcrop was traced by Mr. Dunstan from a point about 40 miles south of the Central line northward to the Isaacs-Mackenzie Junction. The breadth of the outcrop diminishes here to about one and a-half miles. Further west the Lower Marine series is overlain by the coal-bearing beds of the Lower Freshwater series, which are assumed to underlie the greater portion of the Dawson-Mackenzie Valley, where not overlain by the horizontal sandstones and conglomerate of Upper Cretaceous age, which form extensive tablelands on the higher ground between the main streams.

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* See map accompanying Annual Report of Geological Survey for 1889. (G.S.Q., P. No. 58.)

III.—THE BOWEN RIVER BEDS BETWEEN THE ISAACS-MACKENZIE JUNCTION AND THE NEBO DISTRICT.

The tracing northward of the eastern boundary of the coal measures was began by ascending the coast range from the head waters of the Styx River. The tributary creeks of the Styx, under the range, show in their banks beds of hard blue slate, which lie with gently undulating inclinations, and show marked vertical cleavages, the latter striking generally north and south. Overlying them on the higher ground between the creek beds, and up the eastern face of the range, are coarser schists and quartzites, the former showing the same north and south striking vertical cleavages, and giving the impression, on merely surface outcrops, that vertically dipping beds are being passed over. These altered sedimentary rocks are mapped on the Geological Colony Map as belonging to the Gympie Formation, having afforded a few marine fossils of probably that age from the neighbourhood of Mount Brunswick and Granite Creek in this district.

As the range is ascended granite and porphyry is met with, and passed over till the level ground bordering the river on the other side is reached. Here blue shales containing Glossopteris, and evidently belonging to the Lower Freshwater series of the coal measures, are met with along Bottle Creek, just above its junction with the Mackenzie, and below the junction of the latter with the Isaacs. The massive crystalline rocks forming the main massif of the range extend as a spur from the main range for about a mile further south. This spur heads off the waters of Apis Creek, and against it the Mackenzie River is deflected in its course from a north-easterly to an almost southerly direction. From this point northward the plutonic rocks apparently form the backbone of the coastal ranges, which bound the eastern limits of the valley of the Isaacs River, extending as a narrow belt to near the head of the Connors River, where they spread out over a width of about 20 miles in the high ranges to the east and north of Nebo and Mount Britten.

Flanking the plutonic crystalline rocks on the western side of the range near the Isaacs-Mackenzie junction indurated conglomerates, with interbedded rhyolites and tuffs, are found along the bed of Clive Creek. Four miles further north on Bora Creek are gneisses and schists with the same north and south strike and steep westerly dip. Lying uncomformably on these altered rocks and dipping at angles of up to 30 degrees away from them, the fossiliferous limestones and sandstones of the Lower Marine series are exposed in the creek bed under Mount Bora. The limestones are white and crystalline, and are made up almost entirely of shells of productus, spirifer, and crinoid stems. The sandstones are soft and weather easily, affording few exposures even in the banks of the creeks. The road from Clive station, on Clive Creek, follows the left bank of the Isaacs River along a wide alluvial terrace bounded on the north-east by thick brigalow scrub. Near the head of Yatton Creek, about two miles south of the old goldfield, the limestones of the lower marine series were again met with.

They form here a series of low scrubby hills, the varied character of the vegetation on the limestones standing out in marked contrast to that of the open forest timber of box and ironbark found on the less fertile ridges of igneous and metamorphic rocks lying to the north and east. They contain here the same abundant marine* shells and crinoid stems as are found further south. The older rocks of the goldfield and along the heads of Lotus Creek consist mainly of diorites and porphyries, with some outcrops of slate and gneiss. About three miles west of these hills, on the Yatton to Croydon road, ferruginous shales and sandstone, showing fern impressions and apparently of the Lower Freshwater beds, were met with two miles south of Yatton station. Thin even-bedded shales and sandstones with gentle westerly dips are found overlying crumpled and twisted slates, showing marked cleavages perpendicular to the bedding. The latter are evidently of much older date than the former, which were laid down on them since their cleavage was imposed upon them. Otherwise there is little to show that the one series is not conformable with the other.

Similar shales and sandstones are found 18 miles further north, near Lotus Creek station, where they again overlie quartzites and greywackes of the older beds.

From Lotus Creek northward the junction of the Bowen River beds with the older underlying rocks was nowhere observed, the extension of the coal measures being obscured for 60 miles further north, first by the alluvium of the Connors River and Funnel Creek and a wide area of Upper Cretaceous sandstone lying between Funnel Creek and the Isaacs River, and further north by a large area of basalt country forming the open rolling country of Oxford Downs and Fort Cooper stations. The marine sandstones of the Lower Marine beds were again picked up on the road from Nebo to Mount Britten Goldfield, where they are again found with the same regular north-north-westerly strike and south-westerly dip, on the western side of the Eungella and Mount Britten range. They show here abundant spirifer, productus, and other marine fossils of Lower Bowen type.

Soft sandstone and clay shales showing frequent impressions of *Glossopteris* and *Sphenopteris* (?) were found along the Isaacs River above Leichhardt Downs and along its tributaries—Phillips Creek,

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* Mr. Jack (in his "Geology of Queensland and New Guinea," p. 95) has recorded the following fossils from these beds, which he accordingly refers to the Gympie Formation. The fossils are, however, common to the Marine Formation of the Bowen River Beds, as he shows on page 160 of the same work, and I have no doubt from the stratigraphical relation of the Yatton beds that they belong to that Formation. The fossils are—*Spirifera lata*, McCoy ; *Spirifera Stokesii* ; *Martinia Darwinii* ; *Productus subquadratus* ; *Productus*, sp. ind. ; *Aviculopecten limæformis* ; and *Eurydesma*, sp. ind.

North Creek, and Cherwell Creek. These beds no doubt belong to the Lower Freshwater coal-bearing horizon. They lie in gentle undulations, and afford few exposures except along the upper courses of the creeks. They have been denuded down to a peneplain, showing only slight elevations above the general base level of the river, their weathering affording grassy plains and dense brigalow scrubs over wide areas on each side of the river. Between the river and Funnel Creek is a stretch of sandy country drained by Devlin or Rockwood Creek, some 25 miles wide, and stretching 40 miles N.N.W. from its junction with the Isaacs. The few outcrops afforded by this country show horizontal siliceous sandstones, which, in lithological character and general horizontality of bedding, show such great resemblance to the desert sandstones of Upper Cretaceous age, found generally over Queensland that they have been mapped as belonging to that formation.

Several small outliers of the same formation occur to the east of Funnel Creek, while rocks of apparently the same age overlie the lower Permo-Carboniferous rocks over a wide area to the north-west, in the higher ground at the sources of the Isaacs River and Cherwell Creek.

Sandstones and shales containing fern impressions of Permo-Carboniferous facies and showing several outcrops of coal cover a large area along Harvybrandt, Carborough, Walker, Kemmis, and Bee Creeks, all of which drain east and south into Cooper and Funnel Creeks. Around Nebo itself they are overlain along Cooper and Nebo Creek by a sheet of basalt some 70 square miles in area, forming a wide extent of open downs country covered with a rich black soil.

Evidences of former volcanic action in this district are also given by the cappings of trachyte found overlying the heights of the ranges near Mount Britten and at scattered points further south on Mount Donaldson, Mount Landsborough, and the Peak.

A description of the points at which coal has been reported will be reserved till the general geology of the country about Mackay, Nebo, and Mount Britten has been discussed.

IV.—GENERAL GEOLOGY OF THE MACKAY AND NEBO DISTRICTS.

The road from Mackay to the Nebo district passes over low-lying, undulating country, till it reaches the foot of the range which divides the coastal plains from the elevated tablelands drained by the head-waters of the Isaacs and Bowen Rivers. The low-lying country is underlain for the most part by more or less horizontally disposed beds of sandstone and shale, with here and there outcrops of coal and coaly strata. These coal-bearing sedimentary rocks have been traced along the coast, skirting the foot of the range, for about 50 miles to the north and south of Mackay, and with an average breadth of about 15 miles from the coast. On the west they are flanked by the belt of eruptive rocks which constitute the main mass of the range, and form a strip of rough mountainous country some 20 miles in width. This belt of eruptive rocks separates the coal measures of the coast from those at the heads of the Bowen and Isaac Rivers. The coastal beds were early referred by Mr. Jack to his Lower Bowen Formation, on account of their lithological resemblance to them.*

In 1889 they were examined and mapped in some detail for about 30 miles north and south of Mackay by Mr. Maitland.† Remains of the plants *Phyllotheca* and *Glossopteris* were discovered by him near the head of Sandy Creek.

The district was also visited by Mr. Dunstan‡ in 1901, for the purpose of reporting on coal seams at Hazeldean, at the top of the range, and by the writer|| in 1903, for the purpose of reporting on coal seams found on Black Rock Creek, about 20 miles north of Mackay. Up to the present no coal seams of workable thickness and quality have been found in these beds. The beds are, indeed, so much disturbed by contemporaneous flows of basalt and by subsequent intrusions of granite and other plutonic rocks that they do not hold out very great prospects of ever affording very valuable seams of coal. Their geological age is still a matter of doubt. They have, unlike the Permo-Carboniferous rocks along the Isaacs and Bowen Rivers, been considerably disturbed by intrusions of granite and felsite near the Main Range and at various points over the coastal plain, having apparently been laid down before the intrusion of these plutonic rocks took place. The coal measures west of the range, on the other hand, show no sign of such intrusion, and were apparently laid down after the subsidence of the eruptive agencies noticeable along the coast. These latter beds consequently appear to be of somewhat more recent date than the beds found below the range. The effect of the intrusion of the granite on the sedimentary rocks east of the range is well seen as the range is ascended between Eaton and Hazeldean.

As the range is approached, hills of granite begin to make their appearance. The road sections up the range show outcrops of granite alternating with altered sandstones and grits, which are found right to the top, some 1,000 feet above. Judging from their closely-set joint planes and great variations in dip and strike, these beds have been subjected to considerable movement and pressure. They contain

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* On the Geological Features of the Mackay District. R.L.J. Brisb.: By Auth., 1887. (G.S.Q., P. No. 39.)

† On the Geological Features and Mineral Resources of the Mackay District. A.G.M. Brisb.: By Auth., 1889. (G.S.Q., P. No. 53.)

‡ Geological Features of Hazeldean, &c. B.D. Brisb.: By Auth., 1901. (G.S.Q., P. No. 164.)

|| Geology of Mackay and Bowen Districts (Addition to the). W.E.C. Brisb.: By Auth., 1903. (G.S.Q., P. No. 181.)

small coal seams, and have afforded plant remains such as *Phyllotheca* and *Glossopteris*, so that they apparently belong to the same coal-bearing series as the beds found along the coastal plain, their elevated position and altered character being accounted for by the movements to which they have been subjected by the intrusion of the granite mass. Intrusive masses of granite and diorite are also shown on Mr. Maitland's map accompanying his report on the district, at Scrubby Mountain, at the head of Bell's Creek, at Mount Vince (near Walkerston), Mount Catherine (near Black Rock Creek), and many other points over the coastal plain. In many cases these intrusive plutonic rocks have disturbed the general horizontal position of the coal measures, and in some cases have metamorphosed the rocks and their accompanying coal beds in a marked degree.

As the road passes south-westward from the summit of the range, rough ridges of granite are passed over for the next 20 miles, till the Pisgah Range, forming the divide between Denison Creek and Cooper Creek water, is reached. Immediately west of this the granite gives place to a belt of highly-altered sedimentary rocks, which flank the western side of the granite for some 90 miles further north. Along the junction line of these altered sedimentary rocks and the plutonic rocks are the goldfields of Mount Britten, Eungella, and Normanby. South of the Mackay-Fort Cooper road the western edge of the granite is obscured by the basaltic and alluvial soils of Oxford Downs and Fort Cooper. The geological age of the slates and schists has not been determined, no palæontological evidence being as yet forthcoming. They are, however, from their position and highly-altered character, evidently much older than the Permo-Carboniferous coal-bearing rocks which succeed them further west. Two detached outliers of the same rocks occur within the area covered by the Permo-Carboniferous beds further west. The one lies about 20 miles south-west of Nebo, and occupies an area of about 100 square miles, in which lie the copper deposits of Mount Orange and Mount Flora. The second is situated about 14 miles due west of Mount Britten, and is much smaller. In it are the now deserted copper deposits of Mount Gotthardt.

The lower Bowen Beds succeed the granitic and altered rocks to the west. The lowest members of the series are found in the neighbourhood of Mount Britten, where marine sandstone carrying abundant remains of *Spirifer*, *Productus*, *Martiniopsis*, and crinoid stems outcrop over a breadth of some 2 miles. These beds strike about north-north-west, and dip to the west-south-west at angles of from 30 degrees to 60 degrees. When traced to the south they cut out against the underlying slates and schists, the softer sandstones and shales of the overlying Freshwater Series being thus brought directly into contact with the older metamorphic rocks. They were traced north by the writer as far as Hazelwood Creek, near Eungella Station, and on Mr. Maitland's map (*loc. cit.*) they are shown to form a continuous outcrop about 2 miles in width from here to where they were first observed in 1879 on the Bowen River by Mr. Jack. Mr. Maitland maps the rocks on which these marine beds lie about Nebo and Mount Britten as of Mr. Jack's Lower Bowen Series. My own observations between Mount Britten and Eungella led me to conclude that they are of much older date and the mapping has been altered accordingly. There is in fact a distinct unconformity between the slates and schists of Mount Britten and Eungella and the overlying Lower Marine Series.

The country to the west and south of these beds is underlain by gently undulating sandstones and shales of the coal-bearing Lower Freshwater Series, the outcrops of coal on which are described below.

V.—THE COAL OUTCROPS OF THE NEBO DISTRICT.

Coal seams have been known to exist in the Nebo district for the last thirty years, and Mr. Jack mentions in his report (*opus cit.*, p. 2) that as long ago as 1878 two prospecting shafts were sunk on coal in the bed of Bee Creek, above its junction with Hail Creek. Shafts were also sunk in coal in the bed of Walker's Creek, about 2 miles above its junction with Carborough Creek, and about 10 miles due west of Nebo. These shafts have long since been filled in with sand washed down by the stream, but the top portion of the seam can still be seen in the bed of Walker's Creek, about a mile above the junction. Mr. Jack gave the following section of coal strata in the bed of the creek:—

	Ft.	in.
Sandy shale, with lines of very large ferrugino, calcareous nodules in upper part and lines of ironstone nodules in lower part (*Glossopteris* abundant; also a specimen of *Pecopteris*)	13	2
Laminated fireclay (sometimes sandy)	2	0
Compact fireclay (Phyllotheca abundant)	0	8
Dark shale	0	2
Coal	3	5
Gray shale	0	1½
Coal	0	2
Hard red ironstone	0	3
Coal (bottom not seen)	0	9

A specimen analysed had a specific gravity of 1.38, and contained—

Water	2.99
Volatile hydrocarbons	8.71
Fixed carbon (from hard coke)	84.74
Ash (pale brown)	3.56
	100

Mr. Jack remarks:—"The coal of Walker's Creek is an anthracite containing a higher percentage of fixed carbon and a lower percentage of earthy impurities than any coal of its class known in Queensland or New South Wales. It approaches in composition some of the best anthracite of Wales and Pennsylvania."

No attempt has been made to develop these coals. Their distance from a port (the nearest point of the coalfields being some 60 miles from Mackay) and the difficulties of transport across the coastal ranges between Nebo and Eton will probably prevent their being brought into requisition for the present. Judging from the above analysis, their qualities as good steaming coal seem likely to be highly satisfactory.

The fuel ratio (*i.e.*, the ratio between the fixed carbon and the volatile hydrocarbons) of the above sample is 9.73. This brings the coal within the class often referred to as semi-anthracitic. The uses of such coals are practically the same as those of anthracite, and they are generally known in the trade by that name. In addition to their high-steaming qualities, their value as fuel is enhanced by the fact that they are hard coals, standing rough handling, and removal to long distances without making an excessive amount of slack. They are also not subject to spontaneous combustion under ordinary conditions. They are thus eminently suitable for export to distant localities, and can be stored without rapid deterioration. In addition to this, they give a smokeless fuel.

The most favourable area for prospecting lies between Cooper Creek on the east and the Carborough Range on the west, and between Harrybrandt Creek on the south and the head of Hail Creek on the north. The generally slightly inclined character of the beds over this area augurs well for the occurrence of coal at easily worked depths over wide areas. Besides the before-mentioned coal outcrops on Bee and Walker Creeks, coal was observed along the eastern edges of this area as far north as the head of Cooper Creek, at a point about 4 miles due west of Mount Britten and as far south as a point about 3 miles due south of Oxford Downs Station.

Coal crops were also reported to have been seen during the 1902 drought from the head of Bee Creek, near Elphinstone Station, and from near the crossing of the Mackay to Clermont road, about 20 miles further south. These crops were not visited, as they were reported to be covered with sand, and their location and examination would have entailed considerable loss of time.

The level character of the country and general horizontality of the beds do not lend themselves readily to prospecting, so that, in order to give hope of success in locating seams boring will probably have to be freely resorted to; but before anything of the kind is attempted a geological survey of the area in more detail than was considered advisable at the time of my visit should be undertaken.

Geological Survey Office, Brisbane, 6th March, 1905.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

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Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.
PUBLICATION No. 199.

PRELIMINARY REPORT

ON

RECENT DISCOVERY OF GOLD AT OAKS VIEW,

NEAR

ROCKHAMPTON.

(WITH 2 PLATES.)

By LIONEL C. BALL, B.E.,
ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.
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1905.

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LETTER OF TRANSMITTAL.

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Geological Survey Office.
Brisbane, 23rd January, 1905.

SIR,—I have the honour to forward, under separate cover, my Report "On the Recent Discovery of Gold at Oaks View, near Rockhampton," with one plan and two plates.

I have, &c.,
LIONEL C. BALL,
Assistant Government Geologist.

The Under Secretary for Mines.

L.C.B., Photo.

PLATE 1.—OAKS VIEW HILL *(from the west).*

L.C.B., Photo.

PLATE 2.—MAIN WORKINGS, OAK VIEW.

RECENT DISCOVERY OF GOLD AT OAKS VIEW, NEAR ROCKHAMPTON.

LOCALITY.

Oaks View Hill lies nearly in the centre of grazing farm No. 1v, Canoona, four miles north of the Oaks Station. It is distant, by road, 45 miles from Rockhampton, *viâ* Yaamba, Junction Hotel, Canoona, and the Oaks Station; or, instead of the last, *viâ* Isla Park. The new route to the mines passes Isla Park, keeping to the main Broadsound road till within three miles of the hill. The main road is kept in excellent condition, but the country between it and the hill consists of both broken gullies and black soil flats, and the latter will give great trouble in wet weather. However, there is an alternative route leaving the Broadsound road some miles further to the north, and this, though longer, will prevent absolute isolation.

TOPOGRAPHY.

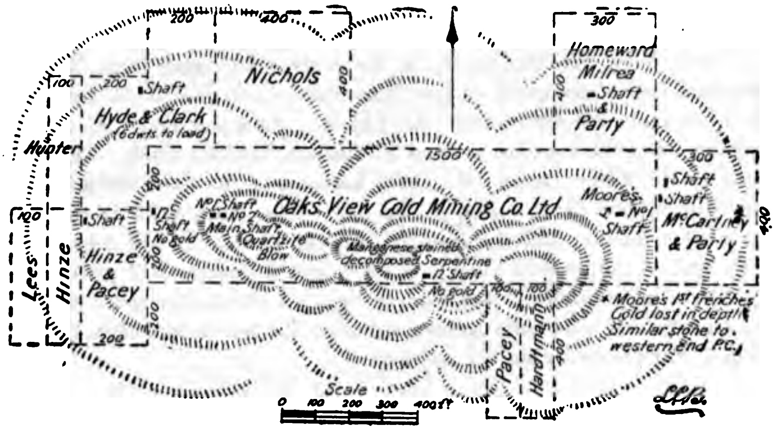
The hill itself (*see* Plate 1), which is about half a mile long and one third of a mile wide, rises only about 150 feet above the black soil swamps on the south, already spoken of. The low melon-hole country on the north and west gradually passes from the flat state into undulations, ridges, and hills, in which the rocks are chiefly quartzites and schists. Though quite isolated from these ridges the Oak View is not the only hill outstanding in the flats. The occurrence of quartzite, which is found intimately connected with the ore deposits, accounts for the resistance of the hill to denudation.

DISCOVERY AND HISTORY.

Mr. W. S. Thomason, in October, 1903, discovered gold by surfacing on Oaks View Hill, but did not proceed further in the matter till February, 1904, when he showed the place to a party of relatives and friends, with the result that payable gold was reported to the Rockhampton Warden in March of the same year. A reward claim (500 by 400 feet) and the usual ground (100 by 400 feet) per man were allotted in due course.

The returns of gold announced being somewhat sensational, a small rush took place. The ground on the east of the reward claim was taken up by Moore's party, who on discovering gold amalgamated with the original prospectors, the combined claims, known as the Oaks United, consisting of eleven men's ground, running east and west for 1,500 feet along the assumed line and north and south for 400 feet across it.

The Oaks United was, at the end of 1904, floated into a company (the Oaks View Gold Mining Company, Limited), with a nominal capital of £24,000, divided into 48,000 shares of 10s. each, of which 24,000 were issued fully paid up, and the remainder as paid up to 5s., this giving a working capital of £6,000.



ROUGH SKETCH PLAN OF OAKS VIEW CLAIMS.

Other claims (*see* Sketch Plan) had been taken up on the north, east, and west of the reward claims, but payable gold had, at the time of my visit, been found on none of them, with the possible exception of Hinze and Pacey's.

TREATMENT.

Treatment thus far (in the beginning of November, 1904) had consisted in dish-washing and cradling, generally without a preliminary dollying. The tailings at the well amount to five tons; 32 cwt. of the uncrushed stuff had been panned off for 92 oz. of gold, and 1 ton 12 cwt., taken from the tailings, had yielded a return of 12 oz. at Aldershot.

The gold saved by these methods enabled the prospectors to purchase a small Huntingdon mill and cyanide plant, which arrived on the field late in December, 1904; but at the time of my visit excavations were being made for a dam, there being no neighbouring stream of water. There are two shallow wells at the foot of the hill, but the water in them is believed to be entirely surface drainage, and quite insufficient to supply a battery.

OUTPUT.

The total gold saved by the above rough method amounted in December, 1904, to 327 oz. 4 dwt., valued at £3 14s. per oz.

According to reports in the Press, 27 tons of stone were crushed at the mine early in January, 1905, for a yield of 4 oz. 6 dwt. per ton.

This, it is presumed, included the tailings above referred to. It was noted that the battery had to close down after this run because of insufficiency of water.*

THE OAK VIEW GOLD MINING COMPANY.

The reward claim and those amalgamated with it, amounting to a total of 1,500 feet by 400 feet, take in practically the whole of the ridge top and the greater part of the northern slope of the hill.

On the very small amount of work done it is difficult to form any definitely favourable opinion. There is now only one small rich area of ground at the western end of the claim, though gold is known to exist, at least in small quantities, over most of the northern side of the hill, and payable gold has been reported from the eastern end of the claim.

WORKINGS.—The main workings (*see* Plate 2) are near the western end (*i.e.*, at the site of the original discovery), the No. 1 shaft lying about 200 feet from the centre of the western boundary. These include a few square yards of "surfacing," two shafts, and two or three shallow trenches. It is worthy of note that cuttings were made about twenty years ago by a prospector named Miller, who found gold within a chain of the present workings, but in insufficient quantities to pay.

The No. 1 shaft, 4 feet by 6 feet, has been sunk 18 feet in a decomposed gossany material (altered serpentine). The main shaft (No. 2) is 45 feet deep, and lies one chain to the east of No. 1 shaft, with which it is connected by an inclined stope.

The stope has a width of up to 30 feet, two drives opening to the northwards from it, one ten feet and one 20 feet in length. From the former an incline extends 50 feet in the same direction as the stope, which stope continues for about 20 feet below the main shaft. A drive to the north from the main shaft is 50 feet long.

Moore's No. 1 shaft, which, being without a windlass, was inaccessible to me, is at the eastern end of the amalgamated claims, about 60 yards north of the south-eastern corner peg and 18 chains east of the main workings. It is 25 feet deep, and from the bottom an underlie has been carried ten feet to the north-east.

The amount of prospecting done is very disappointing, though every excuse must be made for the holders, whose capital for exploitation had to be derived from the ground worked. No doubt when the mill begins to crush proper prospecting will be carried out.

---

* The total crushings for January are now to hand: 119 tons for 227 oz., or 1 oz. 18 dwt. 4 gr. per ton. The great difference between this and the result of the assays is caused, firstly, by the inclusion of rich "specimens" in the crushing; secondly, by the above mentioned patchy nature of the ground worked; and, thirdly, by the fact that the samples were taken from the surface of the heaps, which it is now presumed consisted chiefly of material last raised from the shafts.

Additional crushings are—March, 380 tons for 130 oz. 14 dwt., or 6 dwt. 21 gr. per ton; and April, 86 tons for 62 oz. 18 dwt., or 14 dwt. 15 gr. per ton.

ORE BODY.—The material from the surface to a depth of seven feet in No. 1 shaft, having been found to carry gold, it is intended to put the whole of it through the mill.

Gold was found from the surface to the bottom in sinking the main shaft, and the lower 15 feet of stuff is believed to average 3 dwt. to the ton. The five feet of ore at the bottom corresponds to that in the stope, but is not quite so pumiceous.

In the stope connecting the shafts an average of three or four feet of ore has been removed over the width stated; this consists of about two feet of earthy gossan, with patches of light-coloured serpentine under three feet of gossan, with indefinite, friable quartz leaderlets carrying gold, which is, however, invisible to the naked eye. The quartz is milky and hungry-looking, and includes irregular patches of the original serpentine. The ore seems to be thinning out on the south-eastern side of the stope, though towards the east there is at least seven feet of ore, veined with auriferous quartz.

The prospectors believe that the whole of the ore removed carries payable gold. In two spots, one near each shaft, exceedingly rich prospects can be obtained—in the one case (near No. 1 shaft) from a six-inch band, and in the other case (near the main shaft) from a patch about four feet across and nine inches thick, four feet above the floor, where the gold has been found in masses weighing as much as 2½ oz. Up to half an ounce to the dish was washed out in my presence. In the drive from the main shaft a seam of manganese-stained quartz one-sixteenth to three inches thick carried good gold, the solid metal being found in some places where the quartz cut out. The gold, even in these patches and veins, is very uncertain, and my samples, taken from the ore at grass, point to the general contents being much lower than has been thought.

The ore raised from the main shaft amounts to between 80 and 100 tons, and a surface sample from the heap yielded (Government Analyst):—

Gold—1 dwt. 19 gr. per ton.
Silver—Trace.

That raised from the No. 1 shaft amounts to about 25 tons. A surface sample yielded (Government Analyst):—

Gold—18 gr. per ton.
Silver—Trace.

Throughout the ore and overlying rock slickensides (often coated with a thin film of manganese dioxide) have been developed, and in the lower workings they appear to run to some extent parallel to the footwall. They are the most promising as well as the only sign of permanence observed.

The footwall of the auriferous ground is a light-coloured, clayey, decomposed serpentine. It is very irregular, often rising and falling a foot or two, the fall in one place near the main shaft being as much as six feet. The country of the footwall is readily distinguished from the ore in the stope and deeper workings, but in the No. 1 shaft it has weathered into a substance very closely resembling the ore itself. The dip in the stope is to the north-east, the amount being only 20 degrees.

In Moore's No. 1 shaft 18 inches to two feet of auriferous stone is said to have been struck at 20 feet depth; and in an open-cut trench on the south-western side of it is a very ferruginous, gossany, decomposed serpentine, veined with auriferous quartz, and somewhat similar to the ore in the main workings.

The gold shown me from Moore's workings differs from that in the main workings, being heavier and platy (filling cracks in quartz), while that from the main working is all very finely granular.

The ore, speaking generally, is a soft, highly ferruginous, sometimes manganese-stained, cellular (almost pumiceous), irregularly quartz-veined, gossany material, the result of the alteration, presumably by uprising thermal solutions, of an original serpentine, as indicated by the occasional recognisable, though still altered, inclusions of that rock, and the unfailing presence of specks and flakes of a green chrome-bearing silicate.

About three chains south-east of the main shaft there is a big "blow" of quartz-veined quartzite, which appears to be replaced serpentine, the silica having in all probability been precipitated from the same solutions that altered the serpentine and deposited the gold. In this connection it is interesting to note the occurrence of thin films of hyalite (hydrous amorphous silica) on cracks in the country rock a short distance west of the main workings.

OTHER CLAIMS.

The ground outside the company's is really only being prospected; that is to say, nothing has yet been proved. Shafts are being sunk by the claimholders on the north, to catch at a depth the ore body being worked in the reward claim. East and west of the big claim outcrops, presumed to be on the line, are being tested.

On the unsecured ground to the south-east of Moore's claim considerably altered, ferruginous, quartz-veined, gossany serpentine outcrops, and several loose specimens yielding gold on crushing have been found, but no auriferous deposit has yet been located.

Hinze, Pacey, and Party.

This claim, 200 feet by 400 feet, adjoins the reward claim on the west.

A trench, about seven chains to the west-north-west of the company's main shaft, cut, on what was considered the line of strike, a promising four feet vein of quartz dipping 70 degrees to north-north-east. Specks of gold can occasionally be seen in this quartz, and the fact that they are enclosed in the solid is a very favourable sign. A sample of the stone assayed (Government Analyst):—

Gold—11dwt. 4 gr. per ton.
Silver—3 dwt. 19 gr. per ton.

A shaft adjacent to this trench had been sunk 45 feet, and a crosscut to the reef was being opened in country very similar to that in the reward claim. In sinking the shaft several boulders of magnesite, coloured with the faintest tinge of green, were found, the green colour being very probably due to traces of nickel silicate (Noumeite).

Hyde, Clark, and Party.

This claim takes in ground both on the west and on the north of the reward claim, consisting of two claims, each 200 feet by 400 feet.

The shaft, 55 feet deep, lies eight chains north-north-west of the prospectors' workings. It opened on a bed of quartzite three feet thick, passing out of it at 50 feet depth, where the thickness is six feet, the dip being about 45 degrees to the north. Below the quartzite is a soft, gossany, quartz-veined material, like that in the reward workings, but carrying only a few colours of gold, so far.

Nichols and Party.

Nichols' claim adjoins the reward claim on the north, and Hyde and Clark's on the east.

A shaft, four chains from the main workings, was being sunk in soft, decomposed serpentine, the changes in which appear to dip west-north-westwards at an inclination of 1 in 6. This may be only a local dip, that in the reward claim being 1 in 2 to the north-north-east.

The shaft was 35 feet deep when seen, and it was hoped to strike the auriferous formation of the reward claim within 150 feet from the surface, to which depth the party is prepared to sink.

Of course, it is impossible to say that the dip of the footwall in the reward claim will remain constant, but the sinking of this shaft is justifiable as a means of prospecting the ground.

McCartney, Rea, and Watson ("Morning Star").

This claim, 200 feet by 400 feet in area, is at the eastern end of the company's claims.

A shaft is now being sunk 1½ chains from the north-western corner peg in the expectation of striking, within 50 feet, a quartz reef outcropping to the south; the country is iron-stained, altered serpentine, carrying flakes of green chrome-bearing silicate and bunches of slightly pyritous quartz.

Another shaft, 30 feet deep, a chain south-south-west of the above, struck, at seven feet depth, a reef 6 to 15 inches thick, dipping 45 degrees to the north. Beneath this is eight feet thickness of country replaced to a greater or less extent by quartz, which, though promising in appearance, yielded (Government Analyst) on sampling only traces of gold and silver.

Homeward, Milrea, and Party ("Last Chance").

The claim, 300 by 400 feet in area, lies on the north of the company's ground at the eastern end.

Quartz-bearing country (with reported traces of gold) dipping 1 in 2 horizontally to the north-north-east, had been just struck at the bottom of a 36 feet shaft, the material between 32 and 36 feet depths agreeing in physical characteristics almost exactly with the ore in the reward claim.

Pacey's and Hardtmann's.

These two claims had lately been pegged out on the southern side of Moore's old claim, though it is generally agreed that gold does not occur on the southern slopes of the hill, where these claims lie.

Hunter's.

Hunter's claim, 100 by 400 feet, is on the western side of Hyde and Clark's.

Fragments of manganese-stained quartz lie scattered over the surface for some three chains, commencing about a chain north of the line of strike of the reef in Hinze and Pacey's claim. One outcrop appears to run north-westwards; but as only one or two small trenches have been opened, and as they show only decomposed serpentine, nothing definite can be seen. It is, nevertheless, inferred that this reef is a faulted portion of that in the latter claim.

23rd January, 1905.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

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Geological Survey of Queensland.

PUBLICATION No. 196.

RECORDS.—No. 2,

WITH OTHER NOTES.

(FIVE PLATES).

By B. DUNSTAN,
ACTING GOVERNMENT GEOLOGIST.

CONTENTS:

I.—GOLD DEPOSITS NEAR MOUNT UBI, WEST OF THE BLACKALL RANGE.
II.—THE IRONSTONE OF MOUNT LUCY, CHILLAGOE DISTRICT.
III.—TESTING SAMPLES FOR PROSPECTORS.
IV.—MONAZITE IN QUEENSLAND.
V.—A SOIL SURVEY FOR QUEENSLAND.
VI.—BORING FOR COAL NEAR TOWNSVILLE.
VII.—THE TESTING OF QUEENSLAND COALS.
VIII.—MINERAL NOTES.—AGATE, LITTLE RIVER; GYPSUM TWIN CRYSTALS, EUKALUNDA; TELLURIDES OF GOLD, SILVER, AND LEAD AT GYMPIE; CALCITE CRYSTALS, WITH PYRITES INCLUSIONS, CROYDON.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET

1905.

I.—GOLD DEPOSITS NEAR MOUNT UBI, WEST OF THE BLACKALL RANGE.

(PLATE 1.)

Many years ago, gold was found in small quantities close to Mount Ubi, and in other localities near the Mary River, west of the Blackall Range; but new life has been infused into the work of prospecting by recent developments, and a number of men are now vigorously searching for gold-bearing veins and alluvial deposits. An examination by the writer was made of the localities around Walli Creek and Chinaman's Creek, two tributaries of the Mary River, situated about 20 miles in a direct line westerly from Nambour, a station on the Brisbane-Gympie Railway Line, and about 25 miles south-westerly from Eumundi.

The country passed over in going to the field from Eumundi is mostly granite until Belli Creek is reached, where slate makes its appearance. The slate continues to Mount Ubi Station, near Tamlyn Creek, and on to Walli and Chinaman's Creeks, where granite reappears with diorite, both forming intrusions in the slate.

At Walli Creek, the site of some recent mining operations, syenite and diorite form a coarse breccia, the syenite occurring as a dyke in the larger mass of diorite, and including in itself fragments of the diorite. Polished sections of the breccia show it to be an attractive-looking building stone, the syenite being coarse in texture and mottled black and white, the fragments of the diorite being about two inches in diameter, of a bluish-black colour, and fine in texture. The rock is compact, free from decomposition, takes a fine polish, and could be obtained in large blocks.

Ottrelite slate is stated to occur *in situ* near the workings which have been sunk in prospecting for gold on Walli Creek. Fragments of the rock were picked up on the surface near one of the shafts, but its exact position could not be determined. Probably it occurs close to the junction of the slate with the syenite.

Quartz reefs, large and small, have been formed where the diorite, granite, and syenite are in contact with one another, and close to where they together are in contact with the slates. The reefs or veins which are gold-bearing, however, are very small, frequently narrowing to an inch in thickness and occasionally disappearing completely. They yield good prospects, but the syenite, granite, and diorite forming the walls are so hard, and the cost of mining consequently so great, that the yields of gold from such small veins would require to be several ounces to the ton to make the working of them profitable.

Other reefs exist in the neighbourhood, which could not be examined at the time; but they are said to be bold, strong reefs, sometimes four feet in thickness, but containing only traces of gold.

On Walli Creek, about two miles above its junction with the Mary River, three quartz veins have been prospected by Messrs. Booker and party, the positions of the various workings being indicated respectively on the accompanying plan (Plate 1) by the letters A, B, C, D, and E. At the position marked A, situated low down on the side of the hill and close to the creek, the country rocks are slate and syenite, between which there is a vein of quartz. The outcrop of the vein is exposed in the bank of the creek, and appears to strike north and south, with an underlie of about 60 degrees from the vertical, and having a general thickness of a few inches, but enlarged in one place to eight inches. The vein was searched for a short distance away from the outcrop in a shaft 28 feet deep, but it was not found, probably pinching out altogether.

Further up the bank of the creek, at the junction marked B, a trial hole and trench have been sunk in granite, exposing a quartz vein varying from an inch to six inches in thickness, and containing traces of gold, and having an underlie to the east-south-east at about an angle of 20 degrees from the vertical. Nothing was observed to encourage further prospecting on the vein.

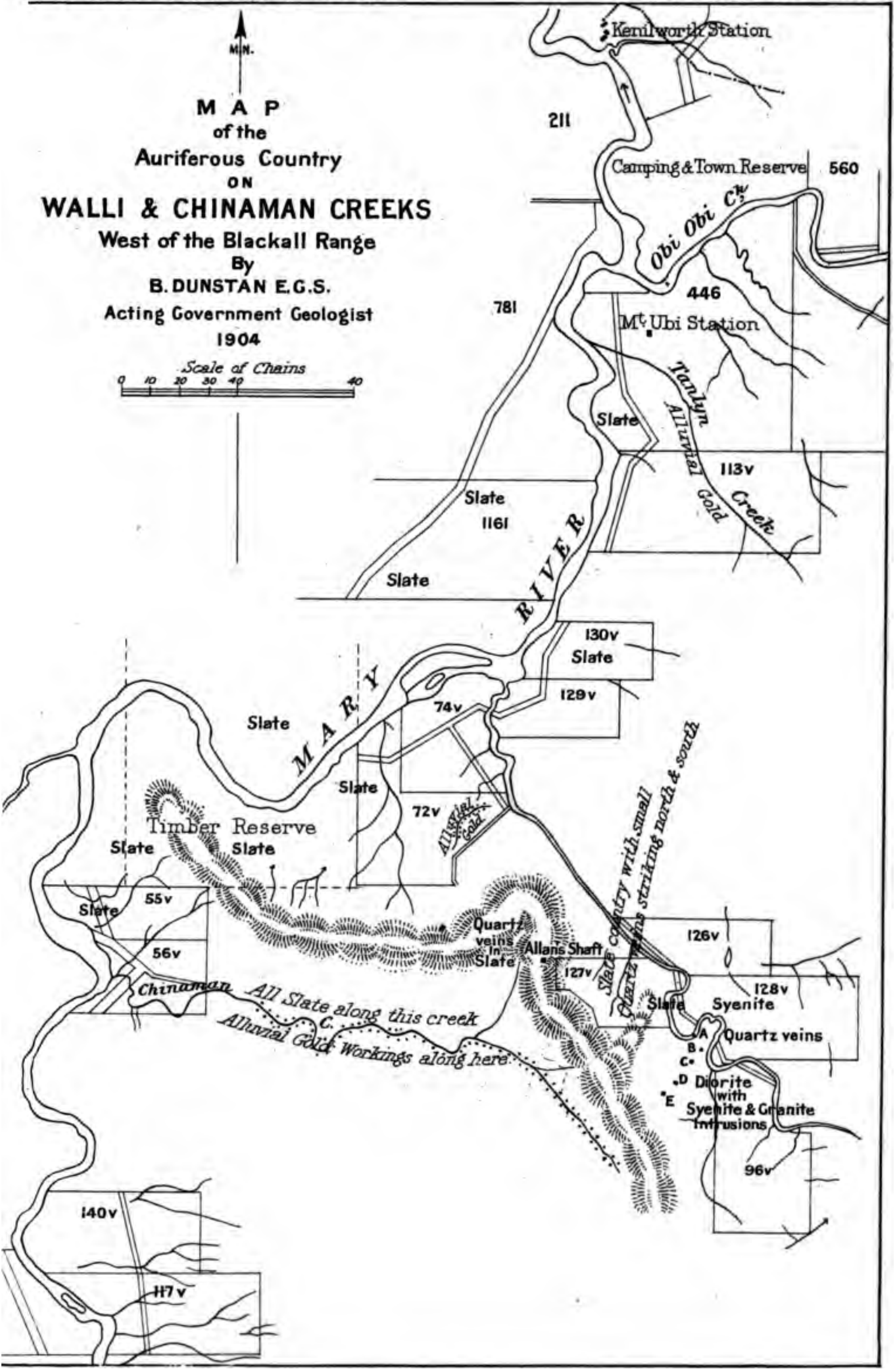
At the position marked C on the plan another excavation has been made, but the workings have fallen in, and have not been reopened.

A shaft was sunk at the place marked D, to a depth of 16 feet, but the vein expected to be found was not discovered, evidently pinching out just below the surface close to the position marked E, where the outcrop occurs. At E, another shaft on the hillside has been sunk in diorite to a depth of 18 feet, but without meeting the vein exposed on the surface. It is here that the syenite-diorite breccia occurs, mentioned above as being a fine ornamental building stone.

Close to the east side of the shaft at E, are other workings. They have exposed the vein which was once considered sufficiently encouraging to warrant this shaft being sunk, but with the results above stated. Copper carbonates occur in traces in this vein.

At Allan's mine, situated on the top of Allan's Ridge (*see* accompanying plan), about a mile north-east from Booker's workings, the country is slate alternating with subangular slate conglomerate, neither granite nor syenite being met with in the mine workings. A few hundred yards south of the mine, however, there is an outcrop of what appears to be a decomposed granitic rock, which, at some considerable depth below the surface, might be in contact with the veins which are known to occur here.

Five veins are exposed on the surface at this mine; all are very small, have a north and south strike, and are nearly vertical. No. 1 Vein has been penetrated in a tunnel driven to a distance of 76 feet, being met with at 66 feet. The vein is about four inches thick, with about three inches of a clay casing, and underlies at about an angle



MAP
of the
Auriferous Country
ON
WALLI & CHINAMAN CREEKS
West of the Blackall Range
By
B. DUNSTAN E.G.S.
Acting Government Geologist
1904

of 10 degrees from the vertical. It is said to contain gold, but none of the stone has been taken out for trial. The tunnel was continued 10 feet beyond No. 1 Vein with the object of striking No. 2 Vein, but has not been driven far enough, the distance between No. 1 and No. 2 Veins on the surface being 20 feet.

No. 3 Vein, 20 feet away from No. 2, varies from two to seven inches in thickness, with an average of four inches. It was worked from the surface to a depth of 15 feet, and several tons of stone were removed, but the work ceased, and the mine is now abandoned and the workings fallen in.

No. 4 Vein, 15 feet away from No. 3, has been worked by a vertical shaft to a depth of 112 feet. The vein was discovered accidentally about eight feet from the surface, has an average thickness of five inches, but varies from half an inch to 15 inches. It is gold-bearing from top to bottom, and two tons, specially tested to prove its value, yielded over two ounces of gold to the ton. This certainly is the most promising vein on the field.

No. 5 Vein has been exposed in a shallow shaft about 40 feet north-west of the shaft on No. 4 Vein. It is about five inches thick in one place, but in a distance of a few feet it pinches to two inches, with several inches of a clay casing. Good prospects can be obtained from the stone by crushing and panning off in a dish.

The alluvial deposits are mostly confined to Chinaman's Creek, although gold was found many years ago at Tamlyn Creek and in one of the watercourses leading into Walli Creek. (*See* plan.) The Chinaman's Creek alluvial deposits, up to the time of the inspection, have only been prospected in a desultory manner, and little information could be gleaned as to the results which were obtained by the miners; but from the more recent operations of the Mount Ubi Gold Mining Syndicate, it would seem that while individual prospecting does not pay, the yields are satisfactory when the work is conducted systematically and on a large scale.

On Allan's Ridge, dividing Walli Creek from the heads of Chinaman's Creek, the veins and leaders are no doubt the source of the gold found in the alluvial deposits, as the rock pebbles and fragments forming the "wash" are identical with the rocks found on the ridge *in situ*.

It has been supposed that mining operations would be more successful if the alluvial gold were traced to the veins from which it has been shed, as the gold would be found to be more concentrated in the veins than in the alluvial deposits. While this might be so, it is more probable that the gold, shed from the numerous small veins and leaders which would not pay to work on Allan's Ridge, only becomes sufficiently concentrated to make the working of it practicable when it is washed into the alluvial deposits of the creek below.

2nd September, 1904.

II.—THE IRONSTONE OF MOUNT LUCY, CHILLAGOE DISTRICT.

(PLATES 2 AND 3.)

◆

Mount Lucy is one of several prominent hills around Almaden, a station on the Chillagoe Railway Line, and has received attention at various times because of the large deposits of ironstone which are known to occur on it. Quite recently it was prospected by a miner for wolfram, who mistook the ironstone for this mineral, which it peculiarly resembles in some of its characters. The tests which have been applied, however, show that it does not even contain traces of this mineral.

Mount Lucy is situated about three miles westerly from Almaden, and is close to the coach road to Georgetown. Between Mount Lucy and Almaden, the hills are all composed of a hornblende-biotite granite containing aplite dykes, quartz leaders, and small irregular quartz masses. Further west of Mount Lucy the granite does not appear on the surface, the rocks exposed being shales, calcareous sandstones, and altered limestones. To the south and north, the prevailing rock is granite.

At the base of the mount, both on the eastern and southern sides, granite is exposed, and near the southern extremity the same rock rises up to within 50 feet of the top. From the latter position the granite has a northerly slope, and is further exposed in the gap between the two peaks (shown in Fig. 1, Plate 2), then sinks below the garnet rock forming the northern end. On the western side the granite is flanked by chert and quartzite, which has been formed, by alteration, from limestone.

From the occurrence of rocks, which are not ironstone, on all sides and on some parts of the top of Mount Lucy, it is clearly shown that ironstone forms a very small portion of its bulk.

The longitudinal section (Fig. 1, Plate 2) shows the position of the granite, the garnet-rock, and the ironstone capping; while the cross section (Fig. 2, Plate 2) showing the rock structures across the lower of the two peaks on the hill, indicates the granite to be the main rock, between which and the chert and quartzite on the western side, a mass of garnet-rock has been formed.

The outcrops of garnet-rock on the hill are partly decomposed, but some portions, which are unaltered, on examination prove to be the garnet variety, Andradite. The garnet-rock has become disjointed in many places, and the cracks have been filled with silica, while much

MT LUCY SECTIONS

Fig. 1
Longitudinal Section
Showing the (1) Granite, (2) the Sedimentary Rocks,
(3) the Garnet Rock & (4) the Ironstone Cap.
Length of Section about 400 feet. Height of Southern Peak about 150 feet

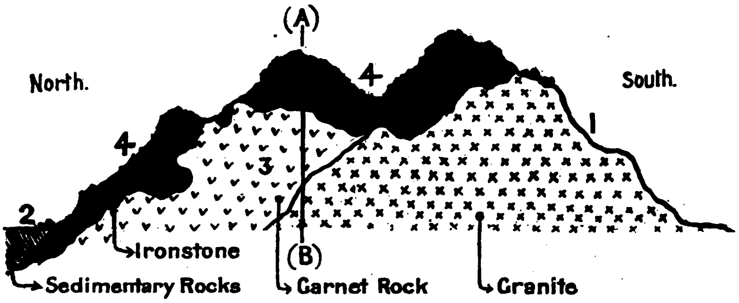
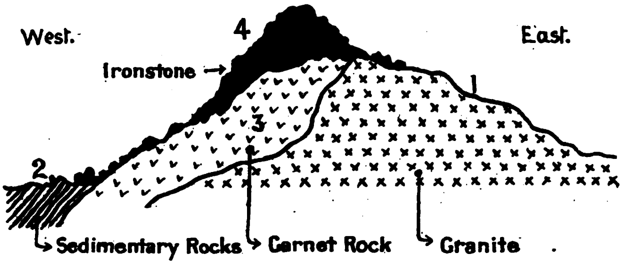


Fig. 2
Cross Section on A B (Fig 1)
(Length of Section about 300 feet)

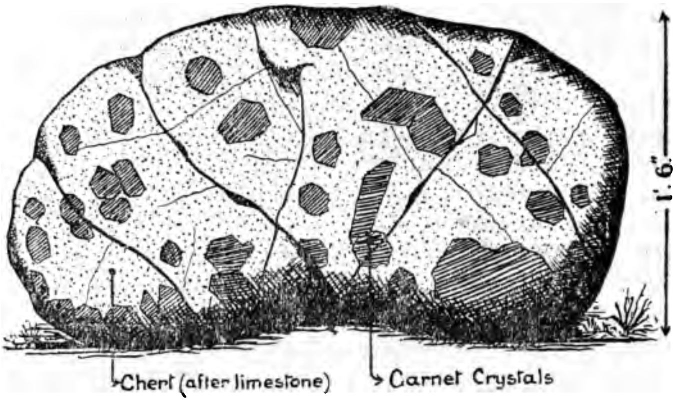


of the garnet has been changed to magnetite. In this condition the rock has been subjected to exposure and to surface leaching, and the remaining portions of garnet-rock, while retaining their form where crystallised, have been to a great extent converted into friable magnetite.

The occurrence of garnet in association with limestone and granite has previously been referred to by the writer in a description of the rocks at Barmundoo, in the Gladstone district,* and of those at Chillagoe.† Further reference need not, therefore, be made here on their general characters and their relations to one another.

An additional feature, however, has been noticed in the occurrence of the magnetite in chert, the former being a pseudomorph after garnet, the latter resulting from the alteration of limestone. Boulders of this mottled rock occur in the northern end of Mount Lucy, a sketch of one being here reproduced. (Fig. 1.) They show that where the contact of the limestone with granite takes place, the andradite garnet has formed, frequently as large massive crystals, and that before the alteration of the garnet took place, the limestone was altered to chert and quartzite, the garnet altering to magnetite at a subsequent stage.

Fig. 1.



BOULDER OF CHERT AND GARNET.—MOUNT LUCY.

The limestones do not outcrop close to the mount, but are exposed about half a mile to the west, where they are somewhat silicified and coarsely crystalline. Closer to the mount the rocks are soft shales and calcareous sandstones, while at its base the cherts are to be found as small rugged outcrops exposed several feet above the surrounding soil.

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* Geological and Mineral Features of Diglum Creek, Barmundoo, Gladstone District, &c. By B. D. Brisb.: By Auth., 1901, page 12. (G.S.Q., P. No. 162.) (Bull. No. 16.)

† "Some Chillagoe Geological Notes," in Ann. Prog. Report of the Geol. Surv. for 1900. (G.S.Q., P. No. 156.)

No opportunity has been afforded to thoroughly examine these cherts, so at present no opinion can be formed as to whether they contain any microscopic organisms.

Wollastonite, with chert, forms very conspicuous outcrops, the light colour of the former and the dark colour of the latter being very noticeable features. The wollastonite, in weathering very easily, helps to exaggerate the rugged structure of the chert, which stands out boldly, while the wollastonite is worn down into crevices and hollows. A sketch of this is shown in Fig. 1, Plate 3.

All the data accumulated during the examination indicate the ironstone to be only a shallow deposit, and there is no evidence to show that it forms anything more than a cap to the mountain. The ironstone is, *in situ*, confined to the top, having its highest position at the south end, and gradually falling towards the north end. There is no indication of its extending below the surface, except, perhaps, where the ironstone is close down to the level of the plain on the northern end. (*See* Fig. 1, Plate 2.)

The total length of the mount is about 900 feet, while its width at the base is about 250 feet, the height above the surrounding country being about 150 feet. The average thickness of ironstone is roughly estimated to be 50 feet, its width to be about 50 feet, and its length about 700 feet. With these dimensions the number of tons of ironstone on the cap of Mount Lucy would be about 250,000 tons. Adding to this the large quantity strewn all around the sides of the mount, which amounts to about 100,000 tons, there will be a total of 350,000 tons, a fair estimate of the quantity of ironstone actually in sight.

The mineralogical characters of the ironstone show it to be between magnetite and hematite. Its crystalline form is that of magnetite, while in colour and streak it resembles hematite. Some of the crystals may be isomorphous after garnet, but there is no doubt that some of the magnetite has been formed without being an alteration product of this mineral.

28th June, 1905.

MT LUCY MINERALS

Fig. 1

Weathered mass of Chert and Wollastonite

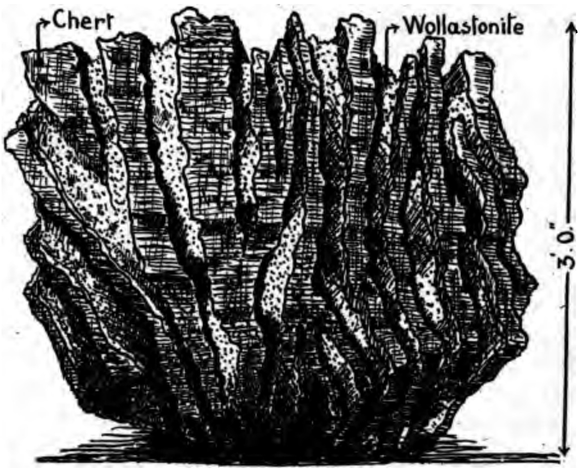
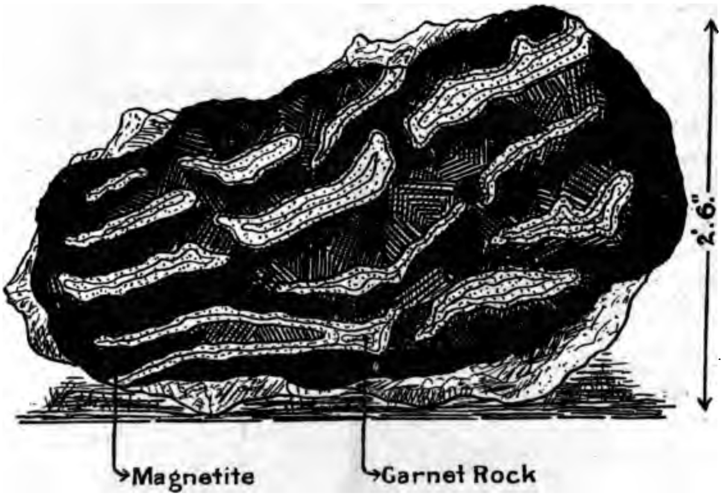


Fig. 2

Boulder of Magnetile showing cleavage
with remnants of Garnet rock partly decomposed



III.—TESTING SAMPLES FOR PROSPECTORS.

Samples of ore are constantly being received by the Geological Survey Office from miners and others who desire to know the commercial value of the minerals they contain, but the conditions to be fulfilled are not generally observed, neither are the samples, except in rare instances, properly prepared for assay.

Minerals and rock specimens requiring simple classification are examined unconditionally, but a stipulation is made that those who require fire assays or chemical analyses of minerals should be prospectors, and also that the samples are from localities which are not well-defined centres of mining development, but rather where the country is being developed after having been abandoned, or where previously no prospecting work has been undertaken.

These conditions are objected to by many, but our desire is simply to assist in the work of mineral discovery, and this object is attained by attending to the requirements of the prospector. When assays are made for buyers and sellers of parcels of ore, or for the purpose of company flotation, the schedule charges are insisted upon. The privilege of obtaining free assays from the Department is no doubt abused to some extent, but this evil might be tolerated in view of the good results which accrue in so many other ways.

There is another condition which most prospectors take exception to at first, but which, nevertheless, is quite in reason—that is, making known the locality from which the samples were obtained. An average of about 10 per cent. of the samples tested give returns which show that the minerals they contain are in payable quantities, the 90 per cent. being of no present commercial value. Of the latter, about 60 per cent. are not even of prospective value, the remaining 30 per cent. possibly being valuable in years to come—when facilities for mining development and for transport become better, and when some of the minerals now worthless will no doubt be found useful in some of the manufacturing industries.

It is also very important that the absolutely valueless mineral deposits—the 60 per cent.—should be recorded to indicate the localities where prospecting work has been futile. It is now known that duplicate assays have been made of minerals from the same locality, separate parcels being sent by different individuals, each of whom, perhaps, was not aware that others had furnished similar samples to be tested. Were particulars supplied regarding the localities, this duplication of assays, and the expense incurred, would be avoided.

Another advantage resulting from the possession of this information would be in enabling advice being given to miners who wish to further prospect a mineral deposit previously examined. Miners could be given the results of previously made assays and tests of mineral deposits they propose to operate upon, if such have been made, and this might result in encouragement being given to further development, or, on the other hand, might indicate that such work would entail waste of labour and money. It has frequently happened that a party of miners, in reopening an abandoned mine, would not have started operations had they known beforehand the result of assays made for those who previously worked the mine.

The preparation of samples for assay and for mineral classification is quite simple, and should hardly need a description. Nevertheless, parcels of stone are frequently received which consist perhaps of a couple of pieces, and which cannot be considered average samples. For the *determination or classification* of any mineral species, good clean pieces are desired, and the quantity should not be too small. In the *estimation of quantities*, such as the percentage of copper or tin, or the number of ounces of gold or silver per ton, it is necessary to carefully prepare the samples. Many will break off a piece of stone from a lode and from that expect a result indicating the average yield of the whole mass, and fail to see that in such a test rich stone may be overlooked. On the other hand, the specimen might give a rich return, and will perhaps result in money being spent in developing the deposit of mineral, after which it might be found that the bulk of the stone is either barren or too poor to pay. The man who supplies the funds for carrying on operations might think the prospector had deceived him as to the quality of the stone, or both might think the stone was not properly tested in the laboratory, and put the blame on the assayer.

The better method of sampling is to take stone from all exposed places on the lode, which must then be crushed and mixed, and afterwards quartered. One quarter is then more finely crushed and again mixed and quartered, the operation being repeated until the bulk is reduced sufficiently to make a small finely-crushed sample weighing two or three pounds. When this is not practicable, very small pieces—say, fifteen to the ounce—should be chipped off all exposed places, from which a sample is taken after finely crushing and mixing. This will give a fairly satisfactory result, although not so accurate as the former method. It would also be as well to include a large chip of the mineral as a guide to its classification.

Attention should also be given to the forwarding of samples. They should have some distinguishing mark, and this should be referred to in the letter of advice. Many samples received are without marks, which causes confusion, and the greatest care has to be exercised in identifying post-marks, or in comparing handwriting, in order to avoid samples from one individual being mistaken for those sent by another.

23rd January, 1905.

IV.—MONAZITE IN QUEENSLAND.

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For some time past monazite has been known to occur in the beach sands on the coast of Queensland, and numerous samples have been sent to the Geological Survey Office for the examination of their monazitic contents.

Many years ago the beach sands near the mouth of the Tweed River were prospected for gold, and in a small quantity of the sand purchased by this office from Mr. Dwyer there were detected platinum and osmiridium, a concentrated sample of which yielded on assay 26.12 per cent. of platinum and 40.02 per cent. of osmiridium. In 1903 another sample, purchased from the same miner, was found to contain a monazite-like mineral, alluvial gold, 2.16 per cent. of platinum, and 1.61 per cent. of osmiridium. During March and May, 1904, other samples of beach sand from near the mouth of the Tweed were submitted for examination, the first one received with the intimation that it was thought to contain monazite. In May an inspection of the beach sands north of the entrance to the Tweed River was made by Mr. Ball, who obtained samples in which the Government Analyst detected the presence of 4.3 per cent. of earths of the cerium group (calculated as oxides and including 0.4 per cent. of thoria). Subsequently information was received that the beach miners were obtaining tinstone, a concentrated sample of which yielded 54 per cent. of tin. This, on a later inspection, was confirmed by Mr. Ball, whose report has already been published.*

The presence of the monazitic sands at the Tweed has resulted in other parts of the coast being prospected, and a bulk sample from the mouth of the Johnstone River, obtained through Dr. MacDonald, of Geraldton, was forwarded by the Department of Mines during March, 1904, to the Imperial Institute in London for examination.

The locality from which this sample was taken, according to Mr.

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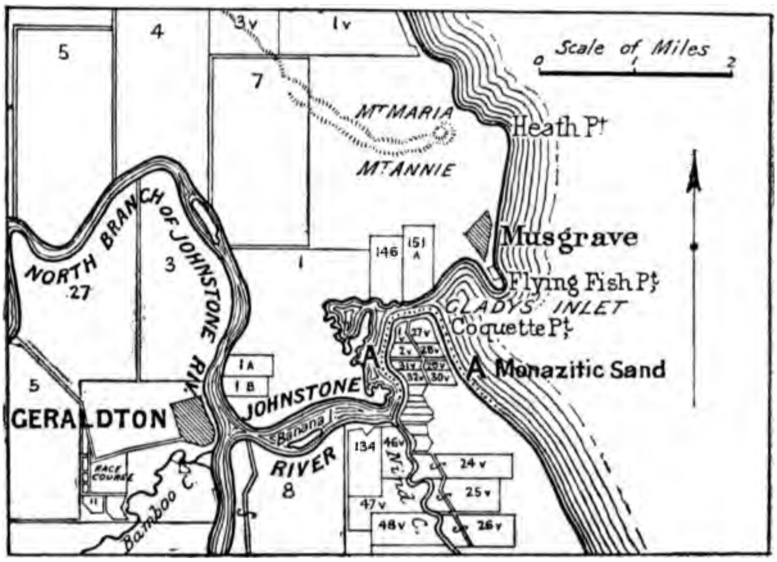
* Q.G.M. Jour. Feb., Vol. vi., 1905. Pp. 62-67.

John Cameron, is inside the entrance to the river on the south side, and is shown on the accompanying sketch plan. Mr. Chapman, who has been examining the beach deposits in the neighbourhood of the Johnstone River, states that there are no iron-bearing sands on the beach on the north side of the river, and he is of opinion that the ocean beach on the south side of the entrance would yield more heavy minerals than the locality from which the analysed sample was taken.

Fig. 2.



PLAN SHOWING POSITION OF MONAZITIC SANDS, JOHNSTONE RIVER.

(Monazitic Deposits along dotted line from A to A.)

This concentrated material was then analysed in the Scientific and Technical Department of the Imperial Institute, and gave the following result:—

Silica, SiO_2	7.59	per cent.
Titanium oxide, TiO_2	44.59	,,
Zirconium oxide, ZrO_2	1.06	,,
Thorium oxide (thoria), ThO_2	0.23	,,
Alumina, Al_2O_3	1.46	,,
Yttria, Y_2O_3	0.10	,,
Ferric oxide, Fe_2O_3	1.24	,,
Ferrous oxide, FeO	36.38	,,
Manganous oxide, MnO	2.79	,,
Copper oxide, CuO	0.05	,,
Lime, CaO	0.79	,,
Magnesia, MgO	1.16	,,
Cerous oxide, CeO	0.46	,,
Phosphoric acid, P_2O_5	0.41	,,
Niobic oxide, Nb_2O_5 Tantalic oxide, Ta_2O_5	0.78	,,
Moisture	0.8	,,

These results indicated the presence of the minerals ilmenite, quartz, garnet, zircon, magnetite, monazite, and possibly tantalite in the "concentrate," and this was confirmed by microscopical examination. The proximate composition of the concentrated mineral may, therefore, be taken as—

Ilmenite (Fe, Mn, Mg)O, TiO_2	84.0 per cent.
Magnetite, Fe_3O_4	1.8 "
Zircon, ZrO_2, SiO_2	1.4 "
Quartz, SiO^2	4.4 "
Garnet and other silicates containing alumina, lime and magnesia	5.0 "
Monazite*	1.2 "
Tantalite	0.9 "
Moisture	0.8 "

* A portion of the thoria may be present as thorite (thorium silicate).

The only constituents of the sand likely to be of immediate commercial value are the oxides of thorium and cerium. The amount of thoria present in the "concentrate" is only 0.23 per cent., and in the crude mineral 0.05 per cent., and the proportion of cerium oxide 0.46 per cent. in the "concentrate" and 0.10 per cent. in the original sand.

Material as poor in these oxides as the present sample, or even the "concentrates" prepared from it at the Imperial Institute, would probably not prove remunerative to work under present conditions. At the present time the value of the "concentrates" as a source of thoria would probably not exceed £2 10s. per ton, assuming that it would pay to extract thoria from such material.

The percentage of thoria could doubtless be increased by removing the magnetite and ilmenite by magnetic separators, but it would seem hopeless to attempt to compete by these means with the Brazilian monazitic sands, which constitute at present the principal commercial source of thoria; these, in the concentrated form in which they are exported, yield from 5 to 8 per cent. of this oxide. A mineral found in Ceylon, and discovered to be a new mineral (thorianite) by analysis at the Imperial Institute, contains as much as 70 to 80 per cent. of thoria, and therefore is of greater value than any other source of thoria. The quantity available appears, however, to be small.

The percentage of cerium oxide in the Queensland sand is double that of the thorium oxide, but the demand for the former is very limited, since, in the construction of mantles for incandescent gas lighting, only 1 per cent. of ceria is used to about 99 per cent. of thoria.

Titanium oxide is present in the concentrate to the amount of 44.59 per cent., corresponding to 9.27 of the crude sands.

* * * * * * *

The only other constituent of the sand likely to possess commercial value is the tantalum. Recent experiments have shown that this metal can be used as a filament in electric glow lamps, and such lamps are now on the market. The "concentrate" prepared from the Queensland sand contained, however, only 0.78 of tantalic and niobic oxides, so that it is improbable that this material could be used as a commercial source of tantalum in competition with the other richer tantalum minerals available.

During an examination by the writer, in December, 1904, of the wolfram fields of Northern Queensland, tests were made of a heavy mineral occurring at several localities on the Walsh and Tinaroo Mineral Fields, which the miners thought might be scheelite, but which blowpipe and other tests indicated to be monazite or some mineral closely allied to it. As the mineral in two of the localities occur *in situ*, close attention was paid to its mode of occurrence. The mineral was first pointed out by Mr. MacMahon, a miner, who wanted to know if the heavy brown mineral being found in small quantities with alluvial tin around Fossilbrook was of any value. Later on, the monazite was identified at Bamford, Old Wolfram Camp, Emuford, Ord, and Coolgarra, occurring only in traces on some of the fields, while in others its presence in quantity constituted a serious hindrance to the cleaning of the wolfram associated with it.

The monazite has only been found *in situ* where wolfram deposits pay to work, so probably other richer deposits are known which have been passed over because of the absence or scarcity of wolfram in them.

The miners have thrown it away as worthless because the wolfram dealers, knowing it was not scheelite, have refused, repeatedly, to take it at any price. A wolfram-mining venture in one place failed, and the mine was abandoned, because the supposed scheelite could not be sold, while at another locality a wolfram miner had accumulated a large quantity of it, and, without considering its prospective value in other respects, was pleased to be told, in time, that it was not scheelite, thus saving the expense of dressing, bagging, and forwarding by rail to Cairns.

Later on, further details of the monazite deposits will be given in connection with the report being prepared on the wolfram fields of Queensland, but in the meantime some information concerning it may be here given for the benefit of those interested in the matter.

The colour of the mineral varies from deep reddish-brown, clove-brown, light-brown, to light brownish-yellow, presenting frequently the colour and lustre of "resin" tinstone. It is semi-translucent on the edges and in thin flakes, but otherwise is opaque. The lustre is somewhat resinous on a fractured surface, but is glassy or shining on fresh cleavage faces. It has distinct cleavages in three directions (as well as others not easily recognised), somewhat resembling in appearance the rhombohedral cleavage of calcite.

With a knife blade monazite can be scratched without difficulty; but, being rather brittle, and separating readily into cleavage flakes, some specimens crumble when scratched, and give the impression that the mineral is rather soft.

The specific gravity is high, being 5.04 (equivalent to iron pyrites); and, while this makes it troublesome to separate from the wolfram in the dressing of that mineral, it affords a very ready means of distinguishing it from most other minerals otherwise resembling it.

Topaz, scheelite, and felspar are minerals commonly found with the wolfram, and by the novice may easily be mistaken for monazite. The topaz may be known by its extreme hardness (being scratched with a knife), but otherwise, in rough specimens, particularly in colour, it has been observed to much resemble monazite.

The scheelite, which may be scratched with a knife, is but a little heavier than monazite and sometimes resembles it in colour, but the three distinct cleavages are absent. The felspar, in its colour and cleavage, may be mistaken for monazite, but it has not a resinous lustre; besides, it is so much lighter in weight, and is not so readily scratched with a knife. The blowpipe reactions are also useful tests in distinguishing these four minerals from one another, but the tests cannot be applied by those having no experience in blowpipe work.

The monazite was observed to occur in pure crystalline masses, sometimes several pounds in weight, and also in small cleavable grains. Both forms are irregularly disseminated in quartz, black mica (biotite), and chloritic mica, and are in association with wolfram, molybdenite, scheelite, tinstone, fluorspar, and mispickel. With the exception of wolfram, these associated minerals are only in comparatively small quantities.

The deposits containing the monazite are in granite country, but close to quartz-porphyry and slate. In the granite, and also at the junction of this rock with the porphyry and slate, irregular masses of greisen have been formed from the alteration of the granite, and it is in this, following closely the behaviour of the wolfram, that the monazite deposits are to be found.

The size of the monazite masses and the percentage of the mineral in the greisen lodes, are abnormally high when compared to foreign monazite deposits, and no doubt a large quantity of it could be obtained as a by-product in the mining of wolfram.

The most important foreign monazite deposits are in Brazil and in the State of South Carolina, United States. The Brazilian mines in 1902 produced about 811 tons of monazite sand, having a percentage of from 5 to 8 per cent. of thoria (the substance so valuable in the manufacture of incandescent gas mantles), the total value being

£16,898 19s. 2d., or about £20 16s. per ton. The South Carolina mines in 1903 produced 340 tons of monazite sand, valued at £13,464, or about £35 per ton.

A preliminary analysis of a clean sample of the Queensland monazite yielded 66 per cent. of cerium and other rare earths (Government Analyst). A commercial sample, uncleaned and without any concentration, yielded 2.6 per cent. of thoria, and 56.1 per cent. of oxides of the cerium and yttrium groups (Basii Turner). This sample, if concentrated or picked to obtain clean mineral, would probably yield 3 per cent. of thoria, which at, say, £5 per unit, would show the monazite to be worth £15 per ton. This return certainly warrants further attention being paid to the occurrence of the deposits as an increase of 2 per cent. of the thoria—making 5 per cent.—would be worth about £8 per unit, or about £40 per ton of monazite.

17th May, 1905.

V.—A SOIL SURVEY FOR QUEENSLAND.

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The advantages which would result from having a survey made of the soil areas in certain parts of Queensland have been so satisfactorily demonstrated that nothing need be stated here in support of the proposition made that one should be undertaken. Something, however, may be added regarding the carrying out of such a project.

A soil survey, it must be clearly understood, must be very thorough in its work if good results are to be expected of it, and this can only be achieved by its establishment on a proper basis, and by the employment of men having a scientific training.

American practice in this respect has been very successful, and may be taken as a guide for us to follow. There, it has been shown, the work of collecting information is being performed by a staff of men who are closely in touch with a geological and mineral survey, and in some of the States all the specialists in geology, mining, agriculture, &c., comprise the staff of what is termed a geological and natural history survey.

Economy and general utility have been made the basis of the amalgamation, as it was found that information bearing on soils, minerals, rocks, physical features, timbers, &c., could be collected by the one survey party, leaving much of the details to be worked out in the laboratories by the mineralogist, petrologist, palæontologist, chemist, botanist, entomologist, and other specialists.

In our own Geological Survey most of the work of the staff is connected with the mining industry, and the increasing demands made on it in connection with the examination of mines and mining districts leaves no time to devote to work of a more general character. With the proposed soil survey, and the existing geological survey, however, the nucleus of a geological and natural history survey could be established, which in course of time would so develop that the work of its officers would be applied to other industries besides mining and agriculture.

A reference to this subject was made in last year's Progress Report of the Geological Survey,* showing that information should be accumulated about all mineral products which could be utilised for industrial purposes, such as mineral fertilisers, pottery and brickmaking material, ornamental and building stones, cement-making material, mineral lubricants, and mineral paints.

26th February, 1905.

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* Ann. Rep. Dept. of Mines, 1903, p. 172.

VI.—BORING FOR COAL NEAR TOWNSVILLE.

(PLATE 4.)

An inspection by the writer was made recently of the developments in coal prospecting close to Townsville, on the Northern Railway Line, and while engaged on this work some data was accumulated regarding the position and depths of some of the bores put down many years ago.

In a report on coal near Townsville,[*] Dr. Jack refers to the existence of coal measures in a railway cutting at Stewart's Creek, 6½ miles from Townsville, on the railway line, in which a small seam of coal was exposed. The analysis of a sample of this coal gave the following results:—

Analysis of Small Coal Seam, Stewart's Creek Railway Cutting.

Volatile matter (including water) ...	53·84	per cent.
Fixed carbon	37·87	„
Ash	8·29	„
	100·00	

The remarks appended show that "the coal is of a remarkably high quality, whether for gas-making or steaming purposes. Should a similar seam be discovered of workable thickness, a great impetus would be given to the manufacturing industries of the North."

In 1888 another report (unpublished) was made by Dr. Jack on the same subject, having special reference to some bores sunk at Stewart's Creek for the purpose of testing the measures containing the small seam of coal referred to above.

The examination made by the writer included an inspection of the various bore sites and the coal-measure outcrops, together with the eruptive rocks in the vicinity, and the opinion was formed that the bores have been put down too close to the eruptive rocks, and that it would have been better to have sunk further north-west, even if the drift, which has been found to be of considerable thickness in the bores, were expected to be deeper before the measures were penetrated.

The rocks exposed on the surface near the railway show that shales and greywackes are interbedded with sheets of basalt and with volcanic tuffs containing impressions of *Glossopteris*, the disturbed conditions which generally prevail indicating that if a coal seam were found it would prove to be unworkable.

---

[*] Geological Observations in the North of Queensland, 1886-7. R.L.J. Brisb.: By Auth., 1887, page 14. (G.S.Q., P. No. 35.)

Two other bores have been put down at Stewart's Creek by the North Queensland Collieries Company, the two bores being 1,000 feet apart. No. 1 North Queensland Collieries Company's bore was sunk in 1903 to a depth of 193 feet by a calyx drill, then continued to 259 feet by a diamond drill. No. 2 North Queensland Collieries Company's bore was sunk in 1904 to a depth of 233 feet by a jumper drill.

At Antil Plains a bore is being sunk in coal measures, but the results, so far, have not been successful.

The following is a list of bores and shafts which have been put down at various times about Stewart's Creek, and their positions are shown on the accompanying plan. (Plate 1.)

STEWART'S CREEK COAL BORES AND SHAFT.

*Twaddles No. 1 Bore—

Position—One chain south of Haswell's Shaft.

Record—89 feet deep in drift. Abandoned.

*Twaddles No. 2 Bore—

Position—At south-west corner of Portion 100.

Record—101 feet in drift. Abandoned.

*Twaddles No. 3 Bore—

Position—At south-east corner of Portion 100.

Record—59 feet in drift, then struck porphyry. Abandoned.

*Twaddles No. 4 Bore—

Position—At the middle of western side of Portion 100.

Record—109 feet in drift, then 39 feet 7 inches in bedded sandstones.

*Simpson and Rodger's Bore—

Position—In Portion 99, 20 chains from northern boundary of Portion 100.

Record—50 feet deep in drift. Abandoned.

*Haswell's Shaft—

Position—Seven chains east of Simpson's Bore.

Record—44 feet deep in drift. Abandoned.

*Townley Coal Company's Bores—

Position—Sunk within a few inches of one another, 30 chains south of Portion 100, on Reserve.

Record of No. 2 Bore—Drift, 26 feet; sandstones and shales, 59 feet; trappean rock, 15 feet; total, 100 feet. Bore abandoned because of an accident.

Record of No. 1 Bore—Drift, 26 feet; sandstones and shales, 58 feet; total, 74 feet.

---

* Report (M.S., No. 19) by Dr. R. L. Jack, dated Townsville, 29th May, 1888.

Shallow bore—

Position—In Portion 122v, west of Townley bores, between creek and railway.

Record—In drift; depth, 10 feet (?).

North Queensland Collieries Company's No. 1 Bore—

Position—In Portion 150, south of Portion 8v.

Record—Drift, 78 feet; coal measures, 181 feet (coal traces at 86 feet, coal and shale band at 123 feet, 7-inch coal seam at 123 feet); total, 259 feet.

North Queensland Collieries Company's No. 2 Bore—

Position—1,000 feet south of No. 1 bore.

Record—Drift, 33 feet; coal-measure sandstones and shaly sandstones, 200 feet 6 inches; total depth, 233 feet 6 inches.

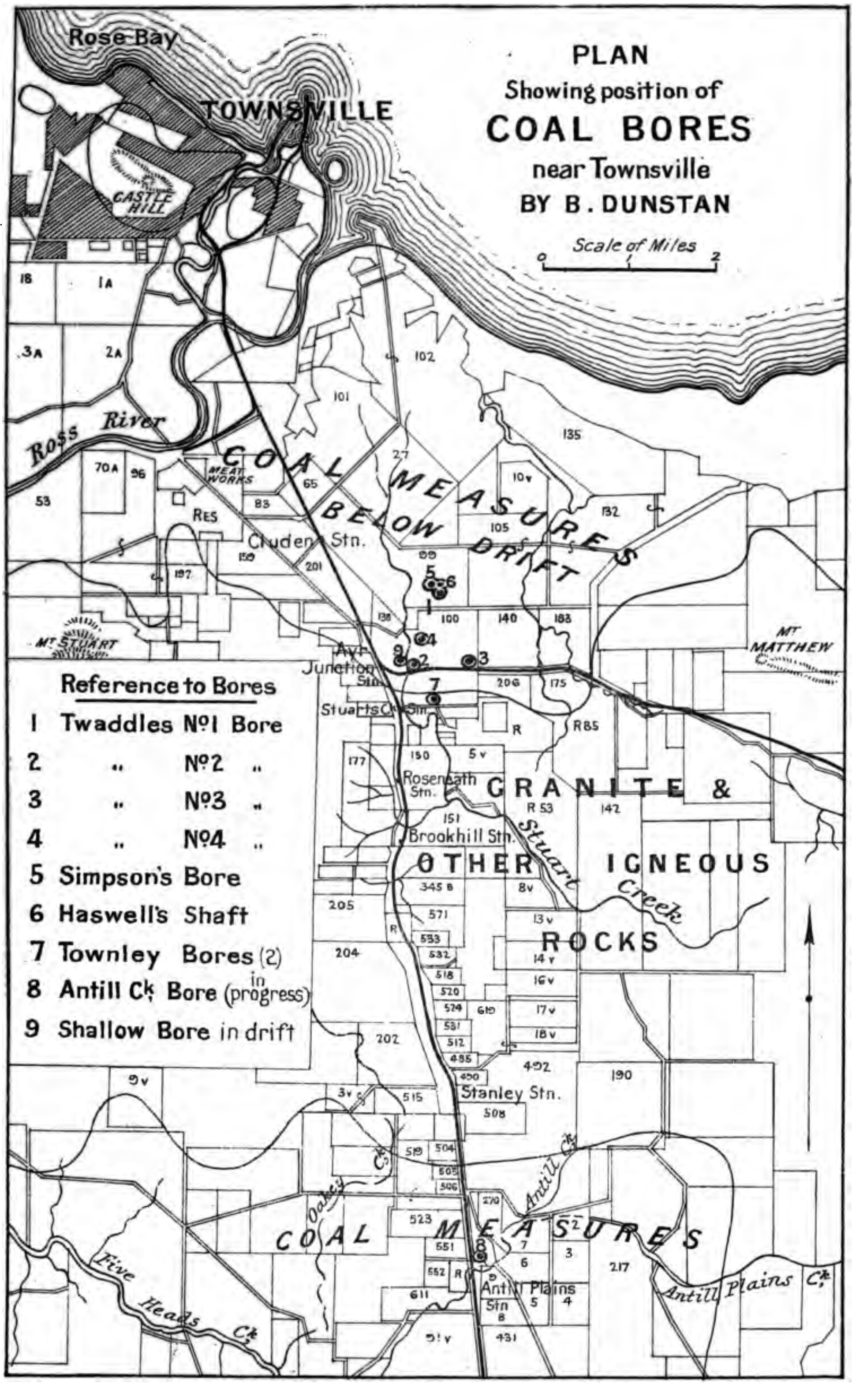
North Queensland Collieries Company's No. 3 Bore—

Position—Near Antil Plains Railway Station.

Record—Coal-measure sandstones; depth, ?

16th February, 1905.

GEOLOGICAL SURVEY OF QUEENSLAND RECORDS No. 2 PLATE 4



PLAN
Showing position of
COAL BORES
near Townsville
BY B. DUNSTAN

Scale of Miles

Reference to Bores

1 Twaddles No. 1 Bore
2 " No. 2 "
3 " No. 3 "
4 " No. 4 "
5 Simpson's Bore
6 Haswell's Shaft
7 Townley Bores (2)
8 Antill Ck. Bore (in progress)
9 Shallow Bore in drift

VII.—THE TESTING OF QUEENSLAND COALS.

◆

The industrial importance of having a series of practical tests made of the numerous varieties of Queensland coals has become so very evident of late that some details of the methods which should be adopted in an investigation might be added to the remark made previously in the Geological Records, No. 1, of 1904.

It may be stated, in the beginning, that we have coals in Queensland which appear to be suitable for every purpose, whether for steam-raising, coke-making, gas-making, smiths' work, or domestic uses.

For steam-raising there are a great number of good coals which can be utilised for general work, some being best adapted for use in locomotive boilers, while others are more suitable for firing marine boilers. Of the latter class, a few have the rare quality of being smokeless, and, therefore, other conditions being favourable, adapted to the requirements of the Admiralty.

Many of the coals are well suited for coke-making, and some of these, with up-to-date plants for washing and coking, would make coke of the finest quality.

In the manufacture of gas for illumination, many of our coals are being used extensively at the present time, and their value in this respect is fairly well known. In the production of gaseous fuel, little is known as to their suitability, and more information on the question is much desired.

The results of numerous tests which have been made from time to time are undoubtedly satisfactory, so far as they go, but no standard tests have been made showing all the qualities of the different classes of coal; and at the present time a consumer of coal has to find out, in the best way he can, which coal suits his particular requirements. For example, the agent of an English firm desired to introduce a plant for making producer gas for fuel purposes, and wanted particulars as to the merits of the coals on the market. This information could not be supplied, and necessitated the firm making its own inquiries and conducting its own experiments to determine whether the coals which could be obtained answered the purpose.

Such tests should be made officially, and would be for the benefit of that particular firm or any others who desired to introduce some innovation by which the consumption of coal would be encouraged.

If ironworks were established in Queensland, and the respective merits of the coals were required to be known, the desired information could not at present be given except in a general way.

The naval authorities require for their warships a coal possessing certain characteristics. They have made trials of some of our coals, and are anxious to make further experiments, and for that purpose want Queensland coal supplied to them. Such experiments and tests should also be tried here according to some standard, the results of which would help the Admiralty in avoiding the trial of inferior coals, and would be of considerable assistance to those who might desire to open up a coal trade to countries outside Australia.

The oversea traffic in Queensland coal is somewhat limited, and vessels have not taken kindly to the class of coals which here have been offered to them. It is known that some firms condemn Queensland coal generally because of the failure of shipments from one locality, but it should be pointed out to the shipper that there are to be obtained several kinds of Queensland coal, some of which would be bound to answer their purpose, and were the standard tests carried out we would be able to show beyond doubt that no necessity arises for their going outside Queensland for their requirements.

The Railway Department use large quantities of coal on their locomotives and in their workshops, and information as to the quality of the coal on the different fields would indicate those which would best suit them.

The necessity of making standard tests, however, would not arise were the coal supplies of Queensland limited in quantity, but there are ready for development immense reserves of coal in both the Southern and Central districts, and recent discoveries show that the Northern district will possibly be a producer of coal, even of anthracite, in the future.

The methods to adopt in testing would take into consideration all the qualities of a coal, so as to determine their fitness for stationary, marine, and locomotive boilers, for coke-making and for smelting furnaces, for use in smiths' forges and for domestic purposes, and for the making of gas for fuel and for illumination.

The examination should include the following tests:—

Ultimate chemical analysis.
Approximate chemical analysis.
Estimation of calorific values by formulæ.
Tests in a standard calorimeter.
Calorimeter tests in a standard boiler.
Trials in a locomotive engine.
Trials in a marine engine.
Trials showing behaviour in transit.
Trials showing liability, or otherwise, to spontaneous combustion.
Trials in a coking-oven.
Trials in a gas retort.
Trials in a gas producer.

The trials and tests should be under the control of a number of professional men, each to be a specialist thoroughly acquainted with some branch of the work, and whose experience, personal supervision, and interest in the work would guarantee the tests being carried out faithfully and systematically.

The constitution of such a body of professional men must necessarily be composed of an analytical chemist to undertake the chemical analyses and the laboratory calorimeter work, and marine and locomotive engineers to supervise the boiler tests. The coking and the gas experiments would be conducted by men expert in those branches, while a geologist would be held responsible for the production of the bulk samples from the mines, would define the position and character of the seams of coal from which the samples would be obtained, and also furnish other geological data concerning the probable supply of coal on the fields.

The above would form a coal-testing board on the lines of many such other boards which have accomplished similar work in other countries, all the members of which, with one or two exceptions, could be selected from officers in the Government service.

6th February, 1905.

VIII.—MINERAL NOTES.

◆

AGATE AT LITTLE RIVER.

Little River is a small stream which is crossed on the coach route between Georgetown and Croydon, and the position of the agate deposits examined by the writer is about 30 miles easterly from Croydon.

The surface rocks are principally Desert Sandstone (?) and a partly decomposed basalt, the latter evidently being older than the former, as the agates which have formed in the basalt occur as pebbles in the sandstone.

The basalt is traversed by quartz veins evidently formed at the same time as the vesicles in the basalt, which are filled with agate, and the abundance of agate pebbles on the surface of the decomposed basalt indicates that a large area of this rock has been subjected to the infiltration of silica. The Desert Sandstone (?) is in part changed to "billy" (the surface quartzite found so commonly in Queensland), and nearly all the hills around are capped with it. Below the beds of sandstones and the flows of basalt the rocks are felsites.

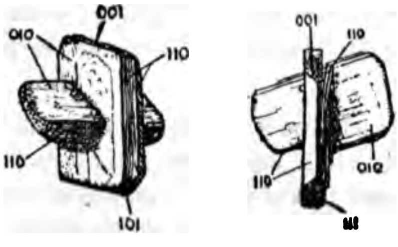
The agates are not of large size, four inches being about the maximum in diameter. The banding and colouring are beautiful in some of the specimens selected for examination, but in the larger sizes the centre is usually crystalline quartz, with calcite also occasionally present. Some specimens, sectioned and polished, are shown in the Geological Survey Museum, Brisbane, and may be taken as types of Little River agates.

At the Percy River, about 60 miles south of Georgetown, more extensive deposits of agates are known; here the nodules of agates are said to be much larger, and in even greater abundance.

GYPSUM TWIN CRYSTALS AT EUKALUNDA, NEAR BOWEN.

Specimens of gypsum penetration-twin crystals have been received by the Geological Survey Office, Brisbane, from Eukalunda, near the Durham Mine, where they are stated to occur in a formation in granite close to sedimentary rocks.

Fig. 3.



GYPSUM PENETRATION-TWIN CRYSTALS.

The accompanying figure illustrates two of the twin crystals, the drawings being made to natural size.

TELLURIDES OF GOLD, SILVER, AND LEAD AT GYMPIE.

Two tellurides, Hessite and Altaite, occur in a number of places below the 600-feet level at the No. 2 South Great Eastern Mine, Gympie. The specimens here described were received some time ago, but have only recently been examined.

The Hessite is of a lead-gray colour; has a bright metallic lustre; fracture, varying from irregular to sub-conchoidal; hardness, about 2; and sectile. The percentage of silver in the mineral is 50.339, that of the gold being 5.049. Tellurium percentage undetermined; sulphur, absent; specific gravity, 8.50.

The Altaite is remarkable for its very distinct cubical cleavage; the colour is tin-white on a fresh facture, which rapidly tarnishes to a greenish-yellow bronze, this on exposure changing to pale yellow-bronze; hardness, 2½; sectile. The blowpipe and other reactions indicate the presence of the tellurium and lead, with traces of sulphur. The percentage of gold present is 0.09, that of silver being 0.70; specific gravity, 8.10.

The two minerals are in a matrix of quartz and calcite, and together constitute about 50 per cent. of the mass. Native gold and minute traces of a brownish mineral (probably siderite) are also present.

CALCITE CRYSTALS WITH PYRITES INCLUSION, AT GOLDEN GATE, CROYDON.

(PLATE 5.)

In the block shaft being sunk at Roger's Extended Mine, on the Golden Gate line of reef at Croydon, a quartz reef has changed into calcite, in the cavities of which calcite crystals have been formed.

Figure 2, Plate 5, shows the general appearance of the crystals as they appear in groups, with the lines of pyrites inclusions passing through them. Figure 1, on the same plate, illustrates the character of the twinning, the pyrites dust inclusions on the terminal faces, and the median line of microscopic crystals of pyrites traversing the group of calcite crystals at right angles with the principal axis.

Brisbane, 8th April, 1905.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

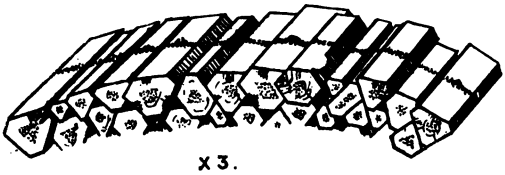
C

CALCITE

ROGER No 1 MINE GOLDEN GATE CROYDON

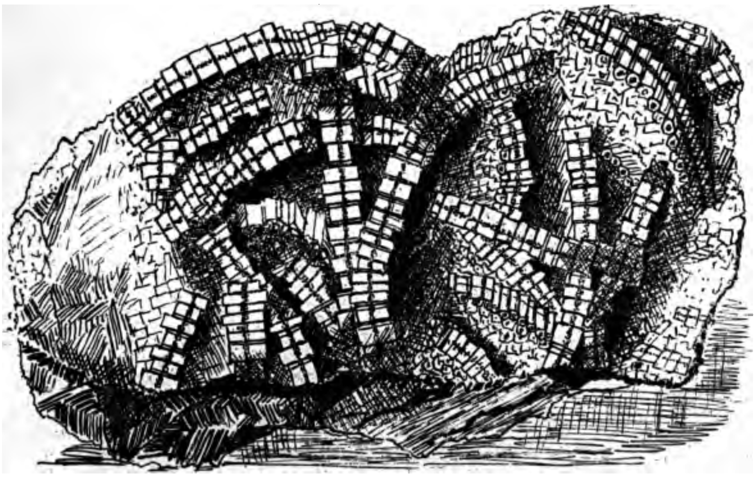
Showing the inclusions of particles of Pyrites
in a twinned group of Calcite crystals

Fig. 1



x 3.

Fig. 2



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Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.
PUBLICATION No. 195.

MOONMERA:

(NEAR MOUNT MORGAN)

ITS MINERALS AND COPPER MINES, AND A STUDY OF ITS ROCK FORMATIONS.

WITH 2 MAPS AND 19 PLATES.

By B. DUNSTAN, F.G.S.,
ACTING GOVERNMENT GEOLOGIST.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1904.

HARVARD
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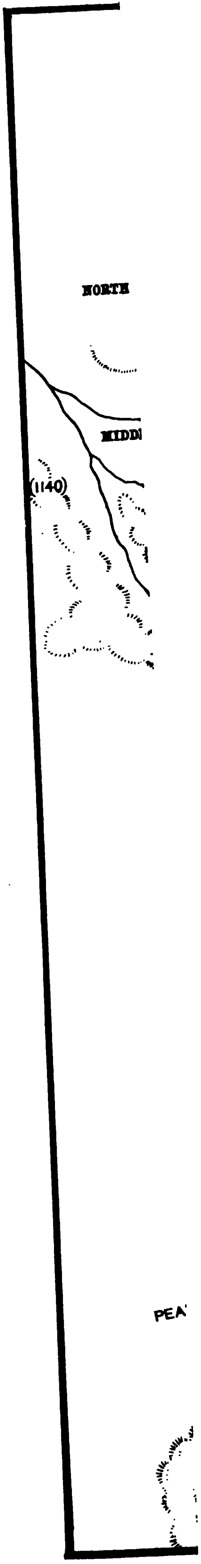
GEOLOGIC



MOONMERA: ITS MINERALS AND COPPER MINES, AND A STUDY OF ITS ROCK FORMATIONS.

◆

INTRODUCTION.

A FEW years ago a great deal of interest was taken in a discovery of copper-bearing rocks in the country immediately to the west of Moonmera, a station on the Mount Morgan-Rockhampton Railway, and since then prospecting developments have been in progress to determine their extent, character, and richness. This work has been carried on continuously and methodically, and, as well as outcrops of ore on the surface being exposed, other masses have been discovered whose existence was not previously suspected.

It was with the view of examining these copper deposits and their associated rocks, and also the Coal Measures overlying them on the higher country in the neighbourhood, that the recent geological survey was undertaken.

Moonmera is situated about four miles north from Mount Morgan, and about nine miles south from Kabra, the station from which the railway line branches off to Moonmera and Mount Morgan. Along the railway Moonmera is 20 miles from Rockhampton, but in a direct line, in a south-south-west direction, the distance is about 15 miles.

The country to the west and south-west of Moonmera is mountainous, and is a portion of the range which, to the north, begins near the Fitzroy River at Yaamba, extends southerly to Westwood, then irregularly to Mount Victoria, Mount Morgan, Moonmera, Moongan (where it is called the Razorback Range), and Mount Usher, and again southerly to the mountains at the head of Raglan Creek and Calliope River to the west of Gladstone.

The watercourses which rise at the Razorback Range take three principal directions. Four-Mile Creek, with other small rivulets to the east of Moonmera Range—a northerly spur of the Razorback Range at Moonmera—trends north-easterly and joins the Fitzroy River near Rockhampton, while Daisy Creek with its branches trends southerly and joins the Dee River to the east of Mount Morgan. The watercourses, westerly from Moonmera Range and north of the Razorback, run northerly and north-westerly to join different branches of Neerkol Creek, which, like the creeks on the east side of Moonmera Range, finds its way to the Fitzroy River in the vicinity of Rockhampton.

The topographical features around Moonmera are of a pronounced character, Moonmera Station being about 600 feet above sea-level, while Middle Peak, to the north-west on Moonmera Range, is 1,300 feet above sea-level, between the two places there being a rise of 700 feet in a distance of about a mile. South from Moonmera the rack-section of the railway to Mount Morgan rises a little less than 300 feet in about a mile, and in the gorges at the head of the Four-Mile Creek some of the surrounding ridges rise up to 500 feet in height in a distance less than half a mile.

The Moonmera Range is capped by rocks having a westerly inclination, and this, with other features, has produced rather steeply-inclined slopes on the western side, while the almost vertical joints in the same rocks have been the principal cause in the formation of the cliffs and the very steep slopes on the eastern side.

GEOLOGICAL FEATURES.

The rock formations of the country around Moonmera have not been examined in detail, but their general features have been observed, and a brief description will assist in comprehending the character of those in the immediate vicinity of Moonmera.

Granite and syenite occur in a large number of places between Moonmera and Table Mountain, in the direction of Kabra, and the formations here are composed exclusively of these rocks. Close to Mount Morgan a large area of the same rocks are exposed, and are probably connected with those at Moonmera beneath the younger rocks of the Razorback Range.

Another series of rocks, varying in age, but closely associated with one another, and presenting many interesting features in their mode of occurrence, are the diorites, felsites, and younger granites of the Razorback. When these rocks were being formed, those which contain the deposit of copper were probably brought into existence, although the evidence obtained from their examination tends to show that the copper-bearing minerals themselves were formed at a much later period.

At Moonmera there is a marked distinction between the granite, syenite, diorite, and felsite formations, as a whole, and the formations resting on them, the latter being stratified deposits of shales, sandstones, and tuffs of Mesozoic Age. A conspicuous geological feature to the west of Mount Morgan is the Marine strata belonging to the Permo-Carboniferous formation, and whilst there are no means of telling whether these old marine beds once existed around Moonmera, there is no doubt that a slow elevation of the Moonmera Range has taken place in past times. Prior to this elevation the beds might have extended much further east than where they are now found, and then to have been worn away before the more recent deposits now resting on the top of Moonmera Range came into existence.

The beds capping Moonmera Range are Lower Mesozoic Coal Measures, and are the edge, or portions of the edge, of the basin containing the Stanwell Beds, more fully developed to the north-west of Moonmera.

There are no well-defined formations in the district later than the Coal Measures, although "Desert Sandstone" was supposed to occur on some of the ranges; but at Moonmera the discovery was made of fossils which indicates the beds to be of the same age as the Stanwell Coal Measures.

During recent times no accumulation of rock-forming material in the neighbourhood of Moonmera has taken place, the work of nature consisting in breaking down the Coal Measures and older rocks, and carrying the *débris* away to form deposits elsewhere.

GRANITIC ROCKS.

The main mass of granitic rocks is exposed to the north of Moonmera, while the smaller outcrops, which are of more recent age, occur at a higher altitude near the ranges to the south. In the railway cuttings, close to Moonmera, the granites and syenites are too much weathered for definite determination, but about a mile north-west from the station undecomposed granite is exposed on the spurs of Moonmera Range, and also in some of the shafts and tunnels in the copper mines.

The older granite is usually found to be medium-grained, but in some localities, more particularly near the head of Deep Creek at the base of Moonmera Range, it is of a coarse texture. The prevailing mica is biotite in the unweathered rock, but where exposed and decomposed muscovite predominates.

The granites of younger age are splendidly shown to the south of the station in the railway cuttings, where they penetrate masses of syenite and felsites, and dykes of diorite. They may be divided into two series by their mode of occurrence, the later formed being conspicuous by their disturbance of the earlier series.

Sketches of portions of the railway sections are shown on a number of plates accompanying this report. Plate 8 illustrates a section on the railway line marked "Cutting A" (*See* Map 1), where a vein of granite and aplite dislocates diorite and felsite masses. Plate 9 shows, on a larger scale, a portion of the same section where the granite is surrounded by a felsite, and also shows the selvage of felsite silicified where the contact takes place between this rock and the more recent granite. The aplite is not confined to any particular part of the mass although it predominates in the narrow portion of the vein.

Plate 10 (*a*), taken from "Cutting B," shows a small vein of (*c*) aplite a few inches thick in its widest part, filling the fault and dislocating a dyke of diorite. The vein tapers away at either end within a distance of a few feet. Plate 11 represents a section in "Cutting B," where a (*b*) granite older than that shown on Plates 8 and 9 penetrates diorite, and is, itself, disturbed by a more recent (*c*) aplite vein.

Plate 12, a section taken from railway cutting (C), illustrates a system of veins of one granite traversing a mass of another, the veins probably being the equivalent of the large mass of granite shown on Plate 11, while the massive rock would be the equivalent of the oldest *(a)* granite. The section is a very interesting one, and, with others in the same locality, would bear considerably more attention from a petrological point of view than can at present be bestowed on them.

On Plate 10 *(b)*, a section from " Cutting B" represents *(a)* syenite as the main rock mass, with *(b)* granite traversing it as veins a few inches thick. With the granite occurs a pegmatite, having vermiculite conspicuous as the mica constitutent. This mineral is found in all the granite and pegmatite veins.

Plate 13 (*a*) represents a section from a small cutting between " E " and " F," and shows a vein of coarse (*b*) granite in a partly kaolinized syenite. The syenite contains small nodular secretions of a fine-grained rock of apparently the same constituents as itself, but containing a greater percentage of the more basic minerals.

Plate 13 (*b*), taken from "Cutting F," shows two veins of (*b*) and (*c*) granite—marked Gr. 2 and Gr. 3 respectively—in a dyke of diorite. The diorite has been dislocated by the first (*b*) granite, and these together—the granite and the diorite—have been disturbed by the (*c*) granite along the line of fault. The (*b*) granite is a biotite granite, while the other (*c*) is a coarse vermiculite granite. (*See* description of Plate 13 *b*.)

Plate 14 illustrates a part of the " Cutting F." The (*c*) vermiculite granite here forms irregular veins in the diorite, and also traverses masses of felsite, apparently enveloped by the diorite. Plate 15 (*b*), from " Cutting G," shows a full-size sketch of a vein of (*b*) or (*c*) granite in a dyke of diorite. The vertical portion is a biotite granite, while the rock in the branch vein graduates into an aplite near the walls, with a vermiculite pegmatite in the centre.

Plate 16, " Cutting G," represents a rather complicated structure, the (*b*) or (*c*) granite being the youngest rock in the section. This granite is of later formation than the friction breccia shown in the section, a feature of some importance in view of a large copper-bearing breccia deposit of similar appearance being associated with felsites, quartz felsites, and the older granite in the Moonmera Copper Mines.

Plate 17 (*b*), from " Cutting G," shows a (*b*) granite vertically penetrating the diorite, both of these rocks being subsequently disturbed by veins consisting of (*c*) pegmatite and (*c*) aplite. Both the (*b*) and (*c*) series contain vermiculite. Plate 17 (*b*), from " Cutting G," shows a (*c*) aplite vein crossing diorite and felsite. The vein is wide in the diorite, and tapers away in the felsite without having even a joint as a continuation of the vein.

Plate 18, representing a section in " Cutting G," shows (*c*) aplite in an irregular vein, but, being of later formation than the diorite, the fault shown at the bottom of the sketch must have been formed *prior* to the infilling of the fissure, and from which it may be concluded that an open fissure existed in the diorite, and subsequently was filled to form a vein of aplite.

At the Moonmera Copper Mines the granite occurs in numerous localities. The section on Plate 1, across the Moonmera Range, along the line A, B, C, D, on Map 2, shows a granite at the base of the Coal Measure conglomerates in the watercourse trending westerly from the Range. Plate 3 shows a section across the granite and felsite at No. 4 Tunnel; Plate 4, a section across the granite and other rocks at No. 7 Tunnel; and Plate 5, a section at No. 2 Shaft, where granitic and felsitic rocks occur in a breccia formation containing copper. The aplite is generally found to occur in both the granular and micro-pegmatite form, some of the latter in microscopic sections showing a beautifully-marked graphic structure.

FELSITES.

The origin of the numerous felsitic masses exposed on the sides of the mountains at Moonmera is rather obscure, and no data have been obtained showing, beyond doubt, what their relations are to the granite with which they come in contact. Apparently some of the felsite masses are immense inclusions in the granite, as undoubtedly others of them are in the diorite. None of the railway sections show the two rocks in contact, and the surface outcrops observed in other places have not resulted in any satisfactory conclusion being arrived at.

To the west and south-west of Moonmera Station the felsite inclusions form prominences on the ridges, and are easily recognised from the decomposed granite and syenite in which they occur. In shape they are usually lenticular, and frequently extend to over 100 feet in length, although the inclusions in the diorite are often very small. (*See* Plate 14.)

In both the diorite and the granite the inclusions have the same "orientation," being persistently northerly, but with an inclination from the horizontal varying up to perhaps 45°. All their peculiarities, especially in their relations to the diorite, point to their being included in rock masses once subjected to a flowing movement.

In the railway cuttings to the south of Moonmera the relation of the felsites to the diorites is clearly defined, and numerous sections show the felsites to be older than the diorite. On Plate 8, the alternating bands of felsite and diorite do not positively prove the diorite to be of later formation than the felsite, but in the sections represented on Plates 10 (*a*), 14, and 15 (*a*) the evidence is unmistakable.

The felsites are intimately associated with the copper-bearing rocks, as shown in some of the workings of the Moonmera mines. Plates 1 and 2 represent what appears to be a "horse" of felsite included in a breccia, although this might be connected with the large mass of felsitic rocks shown in another part of the same section, a plan of which is given on Map 2. Plates 3, 4, 5, and 6 also show felsite in contact with granite, but the relation of these rocks to one another has not been made clear.

A microscopic slice of the felsite from railway cutting (G) shown in section on Plate 15*a*, reveals phenocrysts of quartz with traces of biotite, some magnetite in the form of dust, and a greenish chloritic substance. Another rock slide from the felsite in cutting (B) shows blebs of quartz, biotite mica in traces, grains of magnetite, and needles of apatite disseminated throughout the section.

DIORITE.

Without being able to bring any decided evidence to bear on the matter, the opinion is expressed that the older granites and syenites underlie the diorite. The ascent of the Razorback Range, *viâ* the rack-section of the railway between Moonmera and Moongan Stations, indicates that the granitic rocks are below the diorite in some of the cuttings, and it is only as veins of a younger granite that they are represented on the top of the range in the diorite and felsite. The railway cuttings show the relation of the diorites to the other rocks, and some of the sections reveal remarkable features.

On Plate 8 is represented a number of dykes penetrating the felsite. The centre one is narrow, being about two feet thick, while the one on the left of the section is very massive and irregular.

Plate 10 (*a*) represents a small dyke a few inches thick in felsite, the diorite and the felsite being subsequently disturbed by a thrust fault, the fault afterwards being filled with aplite.

Plate 14 shows the inclusion of a felsite in a mass of diorite, and Plate 15 (*a*) a diorite intrusion along an open fissure in the felsite. Evidently the faulting has taken place at right angles with the plane of section, and the upper portion (*a*) of the felsite has moved forward (at an angle to the plane of the paper) over the lower portion (*b*). These diorite intrusions have taken place along joints produced in the felsite inclusions in the larger diorite masses.

Plate 16 reveals other features. The felsites have been faulted, and the fissure which formed has been filled with brecciated fragments. Subsequently the diorite has been intruded along the same line of weakness, leaving the breccia as the footwall in part, with the felsite forming the hanging-wall.

A slice from a specimen taken from the railway cutting (G) on top of the range, under the microscope showed the rock to be fine-grained, to contain hornblende decomposed in part and stained with chloritic matter, and a plagioclase felspar much kaolinized. Another slice from the same place indicated the rock to be finer-grained, to contain idiomorphic plagioclase crystals much kaolinized, and more or less altered hornblende scattered through it.

BRECCIA.

The breccia formation is made up of fragments of granite, syenite, felsite, and other rocks, and is one of the principal copper-bearing deposits at the Moonmera Mines. Its greatest development is about a mile north-west of the railway station, and where exposed high upon the side of the mountains is very much altered and decomposed, and more or less calcareous, while low down in the ravines it is comparatively fresh, hard, compact, and siliceous.

It has an observed thickness or depth of about 300 feet, rests on granite in a depression evidently formed by surface denudation, and is covered by the sandstones forming the top of the ranges.

Where the sandstones further west have been weathered down and the older rocks below exposed, the breccia has not been found—granite occurring instead—from which it might be assumed, when taken in conjunction with other features bearing on the matter, that the breccia formation is deepest where it is covered by the sandstones at about Middle Peak, and that from this position it becomes shallower in all directions. Resting on the western outcrop of granite (*See* Map 2 and Plate 1) there is a massive conglomerate, which might have been derived from the deposit of breccia. It is composed of the same constituents as the breccia, and is situated at a lower altitude than the upper portion of this rock where exposed on the eastern side of the range. At the same time the breccia and conglomerate might be different portions of one deposit, the western part of which has been formed into a conglomerate by the attrition of the angular fragments in water.

Sections of the breccia are shown on Plates 1 and 2. Plate 1 illustrates the relation of the breccia to the felsites and to the sandstones with which it comes in contact, and is taken along the line A, B, C, D, on Map 2. Plate 2 is a part of the same section on a larger scale, and shows the smaller felsite portion apparently isolated from the main mass further east. From the inclination of the felsite formation at No. 8 Tunnel, where it is in contact with the breccia, and from the apparent isolation of the felsite mass further up the hill, it would appear that a "horse" of felsite has become detached from a larger mass and then enveloped in the breccia formation. (Map 2 shows a plan of this near the section line E F).

Plate 4 shows a section at the mouth of No. 7 Tunnel, where a breccia, consisting of fragments of quartzite in a matrix of felsite, is contained between granite walls, the rock apparently being intrusive. Breccia also occurs in No. 6 Tunnel, where the main formation seems to have been touched at a depth nearly 300 feet below the uppermost portion of the breccia at No. 1 Shaft.

Regarding the origin of the breccia, there is not much information available whereon to express an opinion, but if the breccia occurring in one of the railway cuttings be a guide (shown on Plate 16) then the large breccia formation has been produced by the crushing of felsites, syenites, granites, and micrograntes, and by the consolidation of the fragments into a compact mass. On the other hand, there is a greater probability of its being produced as volcanic ejectamenta, as there are other localities not many miles from Moonmera, in the direction of Westwood, where apparently similar breccia formations occur as volcanic necks; a careful examination of which might reveal further information bearing on the habit and origin of the Moonmera breccia.

CUPRIFEROUS SANDSTONES.

The copper-bearing sandstones occur at the base of the Mesozoic Coal Measures, and for the most part are very irregular and unstratified, and distinct from the overlying formation. They have been formed as detritus from the granite, felsite, and other quartz-bearing rocks, on the inclined surfaces of which they have been deposited. These cupriferous sandstones are 30 or 40 feet in thickness in some places north of the breccia formation, but other parts of the outcrop thin out into an irregular bed only a few feet thick, with granite, felsite, or breccia below, and coal-measure sandstones and tuffs above.

The variation in the thickness of the sandstones is accounted for by the varying angles of slope of the surfaces of the rocks on which they accumulated; and where the sandstones are absent, evidently the slopes of the older rocks have been too steep for the *débris* to rest on. In some places where the dip cannot be observed, it is difficult to distinguish the formation from the Coal-Measure sandstones above, as both partake of the same general appearance where they are in contact. High up on the sides of the cliffs to the west of the breccia formation, where No. 1 Shaft has been sunk, the cupriferous sandstones are absent—the granite rocks and the Coal-Measure sandstones being in contact—but south from the shaft they are present, and in that direction continue uninterruptedly for over half a mile.

The sections on Plates 1 and 2, taken along the line A, B, C, D, and that on Plate 6, on the line E F (*see* Map 2), show the relation of the cupriferous sandstones to the rocks above and below.

Regarding the origin of the copper in the sandstones, there is hardly any doubt but that the copper has been derived from the breccia and granitic rocks, and although the present position of the deposits of copper in the latter is generally lower than the sandstones, numerous features indicate that further east the breccia and granite were much higher at one time, and that the impregnation of the sandstones on their flanks by copper, leached out from the older and higher formations, would be a simple matter.

MESOZOIC COAL MEASURES.

Sandstones and shales of a more or less ferruginous character, fine white thin-bedded tuffs, and a number of small inferior coal seams a few inches thick, constitute the Mesozoic Coal Measures resting on the cupriferous sandstone and breccia of the Moonmera Range. The Measures extend southerly to the Razorback Range, and then continue along the top of the ridges towards the west, occurring also in patches in the country to the north-west in the direction of Stanwell.

The Coal Measures do not occur easterly from Moonmera, although there are indications to show that at one time they must have extended some distance in this direction. Their contact with the formations of breccia, granite, felsite, and sandstones on the Moonmera Range show that their surfaces are rather steeply inclined to the west, and at an angle greater than that of the measures above them which dip in the same direction. As a thickness of 300 feet of the breccia is exposed, its top portion must have been extended much further to the east, where it would come in contact with the older rocks once existing there. The relation of the sandstones, &c., to the Stanwell Coal Measures was a subject of investigation, more particularly as they have been regarded as a " Desert Sandstone" formation.

The coal seams, such as they are, were considered to be of a higher horizon than the Stanwell Coal Seams, and with them to have no connection in any way. The present examination of the country to the west of the Moonmera Range, and also of the Range itself, shows that the rocks do not in any way differ from those of the Stanwell Measures. The sandstones and shales and inferior coal are similar to those at Stanwell, and the white tuffs are identical with those at Stewart's Creek to the north of Stanwell, and with those at Wycarbah near Mount Hay.

The palæontological data recently obtained also indicate their close connection, as the fossils occurring in white tuffs at the head of the gully above No. 6 Tunnel include *Alethopteris Australis* and *Thinnfeldia indica, v. Media,* the latter also being found in several places in the Stanwell Coal Measures. Bivalves occurring in the same tuffs were submitted for examination to Mr. Etheridge, the Curator of the Australian Museum of Sydney, who states that they appear to be the remains of one of the *Unionidæ* or some allied fresh-water mollusc, the distorted condition of the specimens, however, precluding a detailed description being made of them.

The Moonmera tuffs, shales, and sandstones appear to bear the same relation as the Stewart's Creek and Wycarbah tuffs do to the strata close to Stanwell, and may be considered a higher but conformable division of the Stanwell Measures. Further details will be available for consideration when the other portions of the Moonmera series come to be examined in the immediate vicinity of Mount Morgan.

Coal seams outcrop on the side of the Range to the south of South Peak, and the following section was observed by Mr. Rands, who inspected it in 1899:—*

	Ft.	In.
Coarse sandstone (thickness unknown)		
Black carbonaceous shale	2	9
Brown argillaceous sandstone	0	11
Black shales with streaks of coal	0	7
Brown shale	0	6
Black coaly shale	0	7
Brown sandy shale	0	3
Black coaly shale	0	11
Dark brown shale	0	8
Black carbonaceous shale	1	0
Total	8	2

An examination of the exposed section showed the coal to be of a dull appearance and very dirty. Some of the samples of the inferior coal yielded over 60 per cent. of ash, but small bands of the better quality gave about 30 per cent. of ash. The coal may be considered useless, not only from its quality, but also from the absence of seams of workable size. The rugged nature of the country over which the small isolated patches of the Coal Measures extend to the west of the Moonmera Range, would also make the working of a small and inferior coal seam impracticable.

Reference has already been made to the presence of conglomerates above the granite to the west of the Moonmera Range, and to the probabilty of their being derived from the breccia formation.

To the north-east of these massive conglomerates on the eastern side of the Range, another outcrop of a similar rock occurs. Very probably the two outcrops are connected with one another below the covering sandstones and tuffs, as they dip in about the same westerly direction, and are at about the same altitude. The section on Plate 1, taken along the line A, B, C, D, on Map 2, illustrates the position of the Coal Measures with regard to the copper-bearing sandstones, the breccia formation, and the granite and conglomerate on the west side of Moonmera Range. Plate 2 represents a portion of the same section on a larger scale, and shows more clearly the relation of the Coal Measures to the rocks in the vicinity of No. 1 Shaft. Plate 6 represents a section taken along the line E F, and Fig. (*a*), on Plate 7, another somewhat similar section along the line G H, also show the relation of the Coal Measures to the rocks below.

RECENT DEPOSITS.

Deposits of later age than the Coal Measures are very small in area, and are confined to the recent alluvial deposits in the beds of the creeks heading from the Razorback or Moonmera Ranges.

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* Progress Report of Geol. Surv. of Queensland. By Auth.: Bris., 1900. G.S.Q.R. No. 150.

GEOLOGI

Gold has been found in some of the creeks, of which Four-Mile Creek and the creek to the east of Mount Scott have yielded several hundred ounces. The gold appears to have been derived from the numerous quartz leaders and veins which are known to be auriferous in the vicinity of the granite and diorite, especially about Mount Scott, where a large body of stone containing these veins is said to average a few pennyweights of gold to the ton.

Gold has been found in the gullies leading down from the gap between North Peak and Middle Peak (*see* Map 2), the source of which has not been discovered. Some of the old miners suppose the gold to come from the conglomerates at the base of the Coal Measures just above, but there are old alluvial workings in one of the gullies higher than the level of the conglomerates. The gold might have been shed from some of the Coal-Measure beds above the conglomerates, or possibly it has been derived from the older rocks, which, as previously stated, once existed further east at an altitude probably higher than the sandstones.

Small transparent red stones have been found in the creeks west of Mount Scott, and are supposed to be rubies, but none could be obtained to determine whether they were rubies or, more probably, zircons or garnets.

GEOLOGICAL SUMMARY.

From the preceding remarks on the geological features of Moonmera, the following deductions are made on the sequence of the rocks of the railway cuttings and at the Moonmera mines:—

1. The oldest rocks in the district are the FELSITES. They have been clearly proved to be older than the diorite, and the evidence generally shows that they are also older than the granite. They have not been observed to occur in any form other than as inclusions in younger rocks.
2. GRANITES and SYENITES are the next series, a conspicuous feature being their disturbance by diorite intrusions.
3. The third series is the BRECCIA FORMATION, the individual rock-fragments of which are made up of felsites, granite, and syenite, with a conspicuous absence of *débris* from diorite.
4. DIORITE is the next younger series, forming dykes in the granite, syenite, and felsites, and disturbing the friction-breccia deposits occupying a fissure in a felsite mass.
5. Following in order are the veins of VERMICULITE GRANITE which have penetrated the diorite and other rocks.
6. A second series of veins of VERMICULITE GRANITE, PEGMATITE, APLITE, and QUARTZ, which have been formed in the older vermiculite granite and other rocks.
7. FAULTING of the aplite, pegmatite, and other rocks.

8. Accumulation of material to form the MESOZOIC COAL MEASURES.
9. Formation of small bodies and veins of DOLOMITIC LIMESTONE in the decomposing diorites, and the accumulation of material to form deposits containing ALLUVIAL GOLD.

Most of these formations are illustrated in the diagrammatic section on Plate 19, and the changes they have undergone will directly bear on some stratigraphic and other features of the Mount Morgan rocks, which partake of the same general character. The felsites, granites, syenites, and diorites are all similar to those close to or on Mount Morgan, and the information obtained from their examination will be made use of when a study of the rocks of Mount Morgan is undertaken. Regarding the dynamics of the *dykes* of diorite and *veins* of granite, there is enough evidence in the sections exposed in the railway cuttings to show, conclusively, that the theory of intrusion will not account for the formation of the veins of granite in the diorite and other rocks.

As stated before, the granite is intimately connected with aplite and quartz in the same vein, the aplite gradually replacing the granite in some parts, and both changing imperceptibly into a vein of pure quartz. Without losing sight of the changes which might have taken place metasomatically, it is very evident that the granite veins have been produced under the same conditions as those of the quartz veins, and the petrological examination shows no perceptible difference in the character of the quartz where the veinstone is comprised exclusively of this mineral, or where it is associated with other minerals in the granite.

MINING DEVELOPMENTS.

EXPLOITATION WORK.

The principal mining work undertaken at Moonmera has been the exploitation of the copper-bearing deposits on the side of the Moonmera Range, although the alluvial gold deposits in the water-courses, the coal seams on the sides of the Range, the auriferous formations of Mount Scott, and the quartz veins in the diorite and granite, have each received some notice from prospectors.

The exploitation of the copper deposits began many years ago, but the results then were not considered satisfactory, and the operations were discontinued. The finding of other rich outcrops, however, resulted in attention being again directed to them, and ultimately a systematic development of the deposits took place.

Without going into the details of the time and order of developments, descriptions will be given of the formations in which copper has been found. They will be considered under the headings: (1) Deposits in the Breccia; (2) Deposits in the Granitic Rocks; and (3) Cupriferous Sandstones.

DEPOSITS IN THE BRECCIA.

No. 5 Shaft.—This shaft is situated near the western boundary of No. 5 Mining Lease, and has been sunk to a depth of 64 feet in a breccia or sub-angular conglomerate containing fragments of felsitic and granitic rocks.

The breccia also contains blebs and patches of iron pyrites and copper pyrites, with films of molybdenite in the joints. The copper is found throughout the mass of the breccia, but the quantity of metal it contains is not more than one per cent., while most of the stone has less than this amount. Concentrates have been produced from a parcel of stone from this shaft, the yield of which is said to have given 11 grains of gold and 2½ dwts. of silver per ton, and 0.65 per cent. of copper, but there was no estimate obtainable showing the amount of stone required to produce the concentrates giving this return.

No. 1 Shaft and No. 1 Tunnel.—These workings are on No. 3 Lease, on the spur leading up to Middle Peak. The breccia formation here is of immense proportions, and must be over 300 feet in vertical measurement, this being the thickness observed between the outcrop high up at No. 1 Shaft and its lowest position in the ravines.

No. 1 Tunnel has been driven a distance of 65 feet to prospect what was thought to be a lode having a north and south trend, and to be a few feet in thickness, but the developments have indicated that the copper occurs in all directions in the breccia outside this supposed lode.

No. 1 Shaft has been sunk to a depth of 50 feet, on a very rich outcrop of carbonate and oxide ore contained in the breccia formation. Two short drives have been made at the bottom, one to the south, the other to the north, the latter showing oxide and native copper in places. Excavations have been made on the surface, between No. 1 Shaft and No. 1 Tunnel, and some very rich patches of ore containing carbonate and oxide have been exposed.

A sample was taken from 50 tons of stone on the surface, obtained from the north drive and from places in the shaft, and yielded 0.31 per cent. of copper and traces of gold and silver. This stone was thrown out without any attempt being made to separate the richer portions from the worthless stone, so that classification, if adopted, might increase the percentage considerably.

A parcel of 4½ tons of stone taken away from these workings was obtained from some rich "pockets" of ore in the breccia, and sent to a metallurgical works for treatment, and yielded four dwts. of gold and two ounces of silver per ton, and 28 per cent. of copper. A similar parcel sent to another works gave almost the same results. The occurrence of these rich patches of ore created the impression that a rich lode exists, but there is nothing to indicate that such is the case.

From No. 1 Tunnel about ten tons of ore have been separated from the other stone taken out, and a sample of this yielded 1.8 per cent. of copper and traces of gold and silver.

No. 2 Shaft.—This is about ten chains south of No. 1 Shaft, and has been sunk on an outcrop of decomposed copper-bearing rocks, separated from the main body by a mass of felsite. (*See* Plates 5 and 6.)

The shaft has been sunk 50 feet below the floor of the open-cut, and from this a drive communicates with a winze, sunk from the open-cut down to the end of No. 2 Tunnel. The rocks on the surface show carbonate of copper in a number of places, and from various parts here, and from the shafts and drives, a maximum return of 3.8 per cent. of copper has been obtained; the general average, however, being less than 1½ per cent. of copper.

Experiments have been tried in concentrating the ore, and some of the concentrates have yielded nine dwts. of gold and traces of silver to the ton, and 20 per cent. of copper, but an estimate of the quantity of stone required to produce a concentrate of this richness has not been obtainable.

It has been considered that the copper contents of the ore in the winze is about 1.8 per cent., the ore in No. 2 Shaft probably 1.7 per cent., in the cross-cut 1.7 per cent., and in the tunnel 3.25 per cent.; but samples taken from the same workings show on an average only traces of copper, although small bodies of ore occur which yield up to three per cent .of copper. Fifty tons of ore at grass is said to have yielded three per cent. of copper, and that stone picked from this returned 17 per cent. of copper.

In the open-cut a sample was taken from across 18 feet of stone showing carbonates of copper, and this yielded 1.48 per cent. of copper; and a sample taken from a heap at No. 2 Shaft yielded 1.67 per cent. of copper.

DEPOSITS IN THE GRANITIC ROCKS.

No. 6 Tunnel.—The position of this tunnel is close to the south-west corner of No. 5 Lease, and between the workings of No. 5 Shaft and No. 1 Tunnel. It is situated low down in a gully leading from the gap between Middle Peak and North Peak, and was driven for the purpose of reaching the breccia formation. The direction taken is S. 10° E., and the distance driven 32 feet, but the work for the present is suspended.

The rock is a microgranite and represents, *in situ*, the same rock found with others as fragments in the breccia at No. 1 Shaft. Copper occurs as blebs of yellow sulphide, the percentage of copper being less than one per cent.

No. 8 Tunnel.—This is situated in about the centre of No. 3 Lease, and about 15 chains from No. 6 Tunnel. The formations it penetrates are felsite and granite, with a breccia at the end of the drive. The breccia is very compact and contains fragments of felsite, quartz felsite, and microgranite. Very little copper is present, and this is mostly associated with the fragments of quartz felsite.

On Plate 2 is represented a section along No. 8 Tunnel, and illustrates the position of the end of the tunnel with regard to the breccia which the tunnel was driven to strike, and an outcrop of which occurs on the surface to the north-west above the tunnel. Considered generally, the copper occurring in the tunnel is very small in amount, and there are very few tons of stone in sight which would yield over one per cent. of copper.

No. 2 Tunnel.—No. 2 Tunnel is to the east of No. 2 Shaft, and was driven 294 feet westerly, to prospect the breccia formation below the bottom of No. 2 Shaft. The rocks the tunnel is driven through are felsite and quartz felsite (with mica present as a rare constitutent), and a microgranite, and although the breccia of No. 2 Shaft must be very close to the tunnel it has not yet been discovered. Blebs of yellow sulphide of copper (copper pyrites) are seen in the rocks in the tunnel close to what may be considered an eastern boundary or limit of the copper-bearing formation, and on the surface above the tunnel at this eastern boundary copper shows freely on the surfaces of the brecciated rocks. (*See* Plates 5 and 6.)

The Quarry.—This excavation is about four chains easterly from No. 8 Tunnel, and is on the sides and botton of the channel of a water-course. The rocks are felsite and quartz felsite, with mica occasionally present. Portions of the rocks are somewhat brecciated, being made up of large angular blocks of felsite.

The copper occurs in the felsitic rocks very irregularly and very much scattered. Tons of the rock have been quarried (roughly about 200 tons), and from this about ten tons have been picked out, a sample of which, made up of portions of each heap of ore at the different faces in the quarry, yielded on assay 0.69 per cent. of copper and traces of gold and silver.

No. 4 Tunnel.—This tunnel is on the boundary line between No. 3 and No. 4 Leases, and to the south-east of No. 8 Tunnel. Its bearing is north-west, and the length about 140 feet. The open-cut at the entrance penetrated a mass of copper-bearing stone, but the tunnel passed through into a biotite granite, and continued in this rock to the face, the object in view being to cut a supposed extension of the copper-bearing stone found in the short tunnel above No. 4.

The ore at the mouth is contained in a felsite, a quartz felsite, and a much decomposed (?) dolerite, with veins of quartz and iron-stone. A sample for assay was stripped from the side of the open-cut and tunnel, where the ore is exposed, and yielded 2.5 per cent of copper and traces of gold and silver. The formation appears to be about five feet thick, but as the tunnel has been driven in the wrong direction, its extent has not been ascertained.

Close to the end of the tunnel a (?) dolerite dyke was penetrated, and in the granite on the other side there are veins of copper pyrites half an inch thick, but of no importance.

The top tunnel is 20 feet in length, and shows some very good carbonate, oxide, and sulphide ore, contained in decomposed aplite and quartz felsite. A sample was taken from all exposed places, and an assay yielded 3.89 per cent. of copper and traces of gold and silver.

On the roof, floor, and sides of the tunnel the ore is to be seen, but the work accomplished is not sufficient to determine its extent.

The illustration on Plate 3 represents a section along No. 4 Tunnel, and shows the position of the formations at the open-cut and at the top tunnel.

No. 7 Tunnel.—This tunnel is about five chains south-westerly from No. 4 Tunnel. Its bearing is S. 15° W., and its length is 201 feet.

The rocks at the entrance of the tunnel are somewhat disturbed. A breccia made up of quartzite fragments in a matrix of felsite occurs in granite, and in the granite there are irregular veins and patches of quartz, ankerite (carbonate of iron, lime, &c.), and calcite. In the granite close to the breccia there are a few fine veins and threads of copper pyrites with molybdenite.

The tunnel was driven to reach a body of stone supposed to extend downwards from the outcrop of copper ore on the crown of the hill, but it has not yet been found. The rocks in the tunnel are a biotite granite, a friable felspathic rock impregnated with iron pyrites, and a quartz felsite at the face containing traces of molybdenite.

The outcrop above No. 7 Tunnel shows copper carbonates with iron oxides freely distributed in a decomposed felsite. A sample was taken from the exposed places in the trenches, from about ten tons of ore at grass, and also from what was exposed *in situ* on the surface. Portions of the stone exposed in the trenches showed no copper at all, and these were not sampled. The returns from the assay showed 3.85 per cent. of copper.

Plate 4 illustrates a section of the tunnel, and shows the position of the outcrop of copper ore on the crown of the hill.

No. 3 Shaft.—This shaft is 50 feet deep, and is situated about 15 chains north-westerly from the outcrop above No. 7 Tunnel, and is on the line of section G H represented on Plate 7. The formation in which the shaft is sunk is a pale-greenish, friable, partly decomposed felspathic rock, containing abundance of cubical iron pyrites, and is not copper-bearing. About 20 feet to the south-west of the shaft a trench has been cut on an outcrop of copper-bearing rock showing carbonates. The rock is similar to that in the shaft, only more decomposed and iron-stained. The copper also occurs on the faces of a low cliff close to the trench, but the prospecting work at the base of the cliff does not show any features indicating a continuation of copper in depth, although the few tons of stone around the trench above must average two or three per cent. of copper.

No. 3 Shaft was sunk to prospect for gold as well as copper, because of the resemblance of the stone in the outcrop to some of the auriferous stone occurring in the Mount Morgan Mine, but the results were not satisfactory. The heap of stone at the shaft, which might contain about 50 tons, was sampled over the surface, and the assay of this yielded traces of copper, gold, and silver.

A sample was taken of the surface stone at the cliffs and the trenches, and from the ore at grass, but only stone was taken in which copper was present, barren portions being excluded. This sample yielded 0.96 per cent. of copper and traces of gold and silver.

The rock in which No. 3 Shaft has been sunk, evidently extends south-easterly to the outcrop above No. 7 Tunnel, and also below to the tunnel level as shown in Plate 4.

Copper is also present in the rocks of the same belt about 50 feet to the north-west of the outcrop above No. 7 Tunnel. A small excavation has been made, and the ore exposed shows a resemblance to that above No. 7 Tunnel.

Other Localities.—An old abandoned shaft situated easterly from No. 5 Shaft was examined. It is 15 feet deep, and is sunk on a decomposed felsite traversed by a vein of aplite, both of which were found to be impregnated with copper carbonates and copper pyrites. The appearance of the vein suggests that more should be known as to its extent. Copper carbonates also occur on the surface of the ridge further to the east.

Another old shaft, 25 feet deep, situated south-east of No. 7 Tunnel, and outside No. 4 Lease, was examined. The formation is a decomposed felsite and granite, with fine veins of carbonate and oxide of copper. About one ton of stone is lying about on the surface containing, perhaps, five per cent. of copper, but the bulk of the stone taken out does not show copper at all.

CUPRIFEROUS SANDSTONES.

North Tunnel.—This tunnel is situated on the central one of the three leases north of those belonging to the Moonmera Copper Company, and is about ten chains east of North Peak.

The formation is sandstone, more or less ferruginous and clayey in parts, with interbedded gritty ferruginous tuffs. The sandstones are impregnated with blue and green carbonates of copper and the red oxide (cuprite), while the red tuffs in patches are spotted with the carbonates.

The tunnel is driven westerly along the dip of the copper-bearing sandstones, which are exposed for some distance along its sides and at the face. Samples were taken from all the exposed places in the tunnel showing copper, also from one ton of picked ore at the entrance, and from about 20 tons of ore in the paddock near the entrance. The result of this, on assay, gave one per cent. of copper, and traces of gold and silver.

Cliffs near South Peak.—On the edge of the cliffs to the east of South Peak, which is the most southerly of the three prominent peaks on the Moonmera Range, there is an exposure of the cupriferous sandstones below the regular-bedded Coal Measures. This formation extends northerly and southerly (*see* Map 2), and shows traces of copper in several places.

On an exposed cliff, about twelve chains south-east of South Peak, marked "Copper" on Map 2, the sandstones are impregnated with carbonates and red oxide of copper, some portions of which undoubtedly are very rich. Concerning these rich portions no definite opinion can be expressed, as they are simply outcrops, their richness probably being due to the leaching out of the copper from sandstone not exposed, and deposition taking place on the sides of the cliffs. The sample taken from here yielded 2.68 per cent. of copper, and traces of gold and silver.

Other Outcrops.—Sandstones, containing rich patches of carbonate of copper, occur in numerous other places along the cliffs, and some of these patches of ore undoubtedly have been formed by the leaching out of the copper to form efflorescences below the overlying rock ledges.

Summary of Mining Work.

In reviewing all the work which has been in progress at the Moonmera Copper Mines, it becomes apparent that, although some of the prospecting work has yielded satisfactory results, most of the work has been unsuccessful in establishing the existence of well-defined bodies of copper ore.

A few of the outcrops show signs of being permanent, but others are irregular and unreliable in their occurrence. That copper ore exists in enormous quantities is unquestionable, as outcrops of ore can be observed in a vast number of places high up on the mountain slopes in the sandstones and breccia, and lower down in the belt of granitic and felsitic rocks.

Of the most promising localities where developments have exposed the formations carrying copper, or are in positions favourable for working, No. 6 Tunnel should first be mentioned. The further extension of this tunnel may not be in accordance with the scheme of development laid down; but, after all, it is more important to first prospect the ore bodies and find out their value, than to put in levels for working the mine and then prospect for ore-bodies afterwards.

Quite possibly No. 6 Tunnel would reach the breccia if extended a short distance, and the finding of this formation so far below No. 1 Shaft would reveal what its character and quality are in depth.

No. 1 Shaft and No. 1 Tunnel are favourably situated, and should it be found advisable to further prospect the breccia, these workings will be found to be in a good position for development.

The developments at No. 2 Shaft in the breccia formation show very decidedly what the stone is like in this neighbourhood, but as No. 2 Tunnel has failed to reach the breccia, an alteration in the direction of the tunnel by driving more to the north would probably be more successful, as the inclination of the breccia formation is north-westerly.

No. 8 Tunnel, as well as penetrating the breccia exposed above the tunnel, is also prospecting the breccia in which No. 2 Shaft is put down. Both these workings are on the same belt, the outcrop of which extends from No. 2 Shaft in a north-easterly direction to the hill in which No. 8 Tunnel is driven.

The Quarry, near No. 8 Tunnel, does not yield any definite information concerning the trend of the rocks in the neighbourhood. Although there are possibilities of its being connected with the copper outcrops at No. 4 Tunnel as has been supposed, there is very little evidence to be obtained from it on which to base an opinion, and the copper belt, if such a thing exists, might be in quite a different direction. The individual outcrops in this part of the granite area, and also in other parts, are so numerous that it would be very easy to fall into the error of supposing that a connection exists between several of them, and to assume that they were the various outcrops belonging to more or less defined lode formations.

Work should not be continued at No. 4 Tunnel, unless it is to explore the small formations passed through on the east side, but the tunnel above No. 4 Tunnel, named the "Top Tunnel" on Plate 3, should be prospected, if it were found necessary to determine the extent of the ore body there.

In No. 7 Tunnel work should not be continued until the outcrop above it on the crown of the hill has been further examined and more known about its trend.

In No. 3 Shaft the stone has been sufficiently tested to show its quality, and no encouragement can be given to do any additional work here.

Attention is directed to the outcrop of copper-bearing sandstone south-east of South Peak, where prospecting might reveal a body of ore. The stone is good in quality, and, although it might only be rich where exposed, quite possibly it extends into the hill for some distance.

Concerning the North Tunnel, the examination shows that a regular and permanent formation of sandstone of about four feet in thickness is present, and there is every indication of the copper carbonates in it continuing into the hill to the south.

Generally considered, the exploratory work indicates that the copper ore in the granitic and felsitic rocks has failed to give good results, and except where they may furnish some information regarding the occurrence of the breccia, with which they come in contact, it is questionable whether any further exploitations should be made in them. If anything is done, the breccia is the formation in which attention should be more concentrated, but limited to those places previously referred to, while the outcrops of copper-bearing sandstones should not be neglected.

Regarding the mining work, a few words of advice may not be out of place. The practice of putting in large tunnels for development and for working out the ore bodies, before the character of the deposits is understood, is not to be commended under any conditions, and at Moonmera it is evident the deposits have not been understood, from the failure of most, if not all, of the tunnels to penetrate the ore bodies which they were put in to test. Impregnations of granite or felsite, or other such rocks, are always of an uncertain character, and very different to a well-defined lode formation or vein, and so their exploitation should be undertaken on lines altogether different to that which has been followed.

Concerning concentration, it may be stated that, as the ore is a low grade one, it would be necessary to adopt some method of reducing the proportion of gangue to mineral prior to metallurgical treatment. There are very large quantities of ore containing traces up to about two per cent. of copper, and while much of the ore cannot be hand-picked, some of it could be treated in this way, on account of the favourable condition in which the minerals occur in the gangue.

Crushing and concentrating some of the ore could be satisfactorily performed, as trials have shown, and the latest return available shows that 7½ tons, taken from No. 2 Shaft, were concentrated to 16 cwt. containing 12.5 per cent. of copper and six dwt. of gold.

LIST OF MINERALS.

NAME OF MINERAL. OCCURRENCE.

Ankerite.—This iron-lime carbonate is associated with calcite and quartz crystals in decomposed granite at the mouth of No. 7 Tunnel. (*See* Plate 4.) The quartz crystals occur in vughs on which the ankerite, in a massive crystalline form, has been deposited. The calcite is a subsequent crystallisation on the ankerite and quartz. The mineral is white, but rapidly oxidises to a yellow colour on a freshly-exposed surface.

Atacamite.—An oxi-chloride of copper occurring with halite (sodium chloride) on the surface of a friable sandstone near the North Tunnel. Rare.

Azurite.—Blue carbonate of copper. Found in numerous places all over the field. At the North Tunnel it is in the form of small lenticular scales in tuffs and sandstones, and also as impregnations in the latter rocks.

Biotite.—A common mica in the older granites about Moonmera.

Calcite.—In No. 7 Tunnel, associated with quartz and ankerite.

Chalcedony.—Occurs in the felsite in the quarry near No. 7 Tunnel as an encrustation on quartz crystals. Originally the quartz crystals were embedded in copper pyrites, but the latter mineral has been removed and the chalcedony has formed on the crystal faces.

Coal.—Inferior coal occurs on the Moonmera Range, in Mesozoic rocks. (*See* Plates 6 and 7, and Map 2.)

Copper Pyrites.—The matrix of this material is usually the granitic rocks, but it occurs in many different varieties of the acid rocks, noticeably where in contact with those more basic in composition. In the lower outcrops of the breccia it is also found.

Cuprite.—This oxide of copper occurs near the surface of the copper-bearing rocks in the granites and felsites, but it is found far below the surface in the breccia. It is also present in the sandstones on the Range.

Copper Glance.—At No. 1 Shaft and No. 1 Tunnel in small bodies.

Dolomite.—Common as patches and veins in the Moonmera-Moongan railway cuttings.

Galena.—Traces found with the copper pyrites in several of the mine workings.

Gold.—In veins and reefs at Mount Scott, &c. As alluvial deposits in the watercourses east and west of Moonmera Range.

Hematite.—Occurs in the copper-bearing outcrops, and in the sandstones and tuffs on the Range.

LIST OF MINERALS—*continued.*

NAME OF MINERAL. OCCURRENCE.

Halite.—Formed as an exudation in the caves in the sandstone cliffs of the Range.

Hornblende.—In the syenites and diorites in the railway cuttings.

Iron Pyrites.—Common in the Moonmera mine workings; abundant at No. 3 Shaft and No. 1 Tunnel.

Limonite.—On the outcrops of the copper-bearing rocks; also in the sandstone on the range.

Malachite.—Found in numerous places on the field. At North Tunnel impregnates the sandstones.

Melaconite.—Occasionally found as a black coating to the copper pyrites in the mine workings.

Molybdenite.—Filling the joints and occurring as flakes in some of the felsites; occasionally as small masses a few inches in diameter.

Muscovite.—In some of the newer granite veins in the railway cuttings, and in the older decomposed granite.

Native Copper.—In the breccia and sandstones in several places, particularly about No. 1 Shaft and No. 1 Tunnel.

Quartz Crystals.—At No. 7 Tunnel and in the quarry near No. 8 Tunnel.

Vermiculite.—In abundance in the veins of granite and pegmatite in the railway cuttings between Moonmera and Moongan. It is in small scales, having very much the appearance and habit of muscovite. Before the blowpipe it exfoliates remarkably; then fuses to a black glass.

ALTITUDES (APPROX.)

	FEET.
Middle Peak	1,350
South Peak	1,300
North Peak	1,300
Gap South of Middle Peak	1,250
No. 1 Shaft	1,050
North Tunnel	1,050
No. 1 Tunnel	1,015
Coal Seam Outcrop	1,010
No. 2 Shaft	975
Moongan Railway Station	970
No. 3 Shaft	960
¼-mile west of Middle Peak	900

	FEET.
No. 2 Tunnel	880
No. 8 Tunnel	850
Quarry	795
No. 6 Tunnel	780
No. 5 Shaft	778
Top Tunnel (above No. 4 Tunnel)	750
Trenches above No. 7 Tunnel	790
No. 7 Tunnel	680
No. 4 Tunnel	675
Moonmera Railway Station	593
Scott's Creek at Railway Line	548

Brisbane, 2nd September, 1902.

B. DUNSTAN,
Acting Government Geologist.

By Authority: GEORGE ARTHUR VAUGHAN, Government Printer, William street, Brisbane.

PLATE 1.

GEOLOGICAL SECTION ACROSS MOONMERA RANGE.

The geological section across Moonmera Range along the curved line A, B, C, D, on Map 2, shows most of the formation of the district. The granite with the felsite and quartz felsites are the basement rocks, on which have been deposited the copper-bearing breccia to the east and the conglomerates to the west of the Moonmera Range, and above these are the sandstones, tuffs, and inferior coal seams of the Mesozoic Coal Measures.

The altitudes are approximate.

Geological Section across Moonmera Range

SECTION ALONG LINE A B . C . D . ON MAP 2.

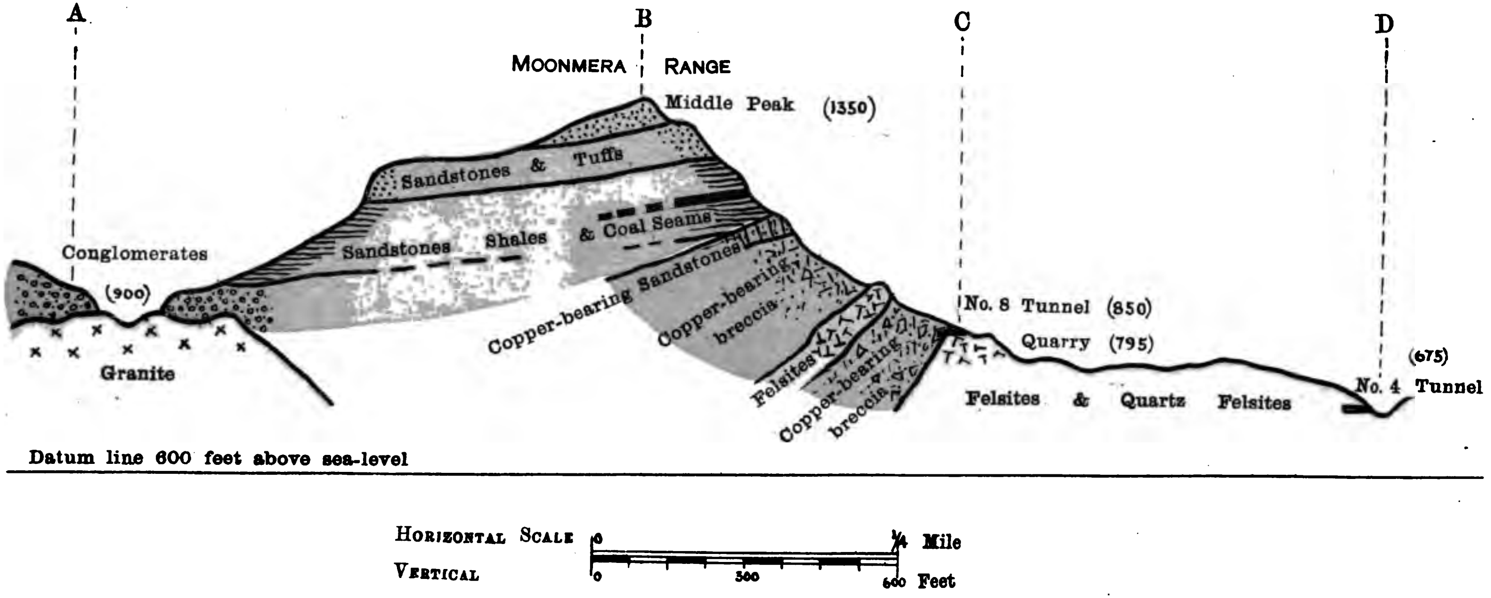


PLATE 2.

GEOLOGICAL SECTION (EAST OF MOONMERA RANGE) ON LINE B C.

The section along the line B C, on Map 2, illustrates the position of the geological formation at No. 8 Tunnel and No. 1 Shaft. At the top of the section are the Coal-Measure sandstones, shales, and tuffs, below which, at a steeper angle of dip, are the copper-bearing sandstones. The felsite "horse" seems to be enveloped by the breccia, and distinct from the mass of felsites further east in No. 8 Tunnel.

Section along line B.C. (Map 2)

(NO 8 TUNNEL & NO 1 SHAFT)

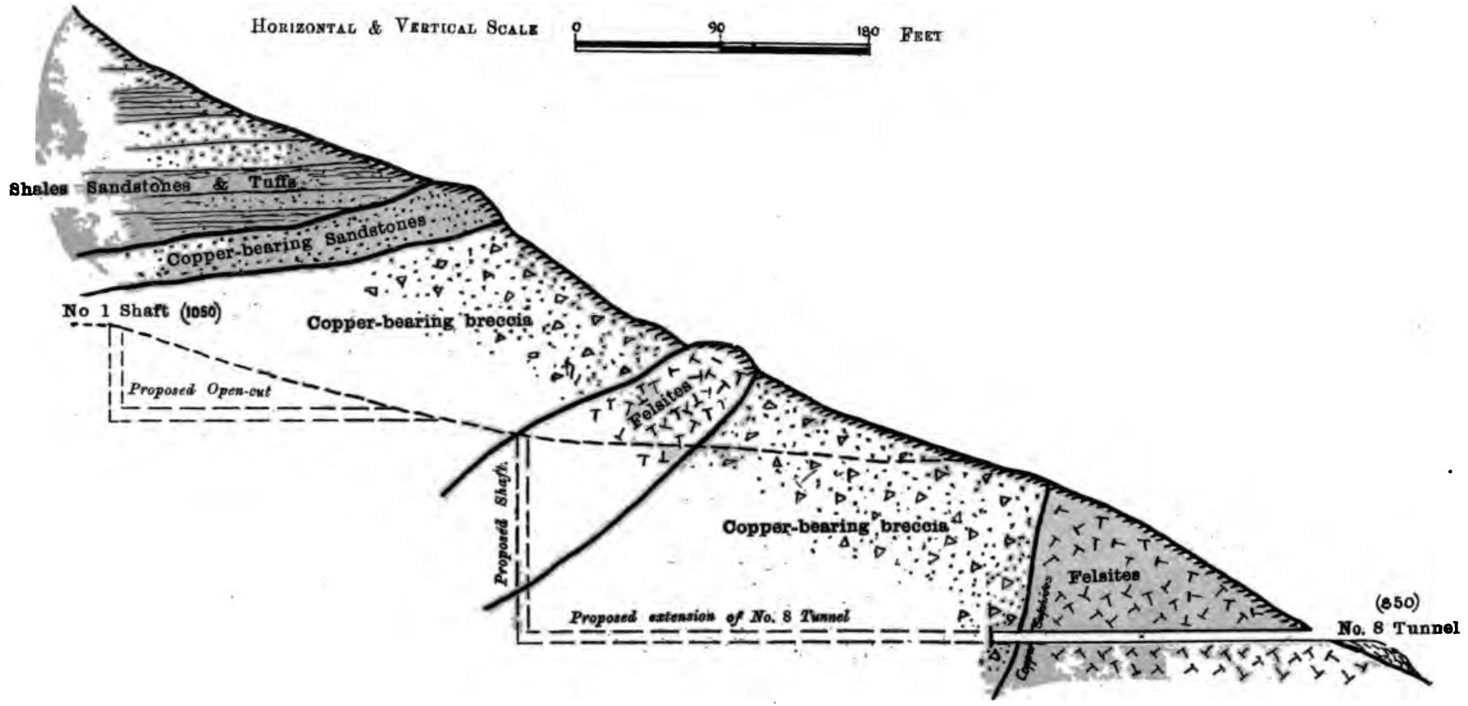


PLATE 3.

SECTION ALONG No. 4 TUNNEL.

The section along No. 4 Tunnel shows the copper-bearing vein in the granite and its relation to the (?) dolerite with which it comes in contact. The course of the copper-bearing vein is at an angle with the direction of the tunnel, and, in consequence, the vein has been cut and passed through obliquely. At the end of the tunnel a few half-inch veins of copper pyrites in granite was found near another (?) dolerite dyke, but of limited extent.

The Top Tunnel copper impregnates the granite and quartz-felsite, but no lode formation exists.

Further references to No. 4 Tunnel are made on page 21.

Section along No. 4 Tunnel (See Map 2)

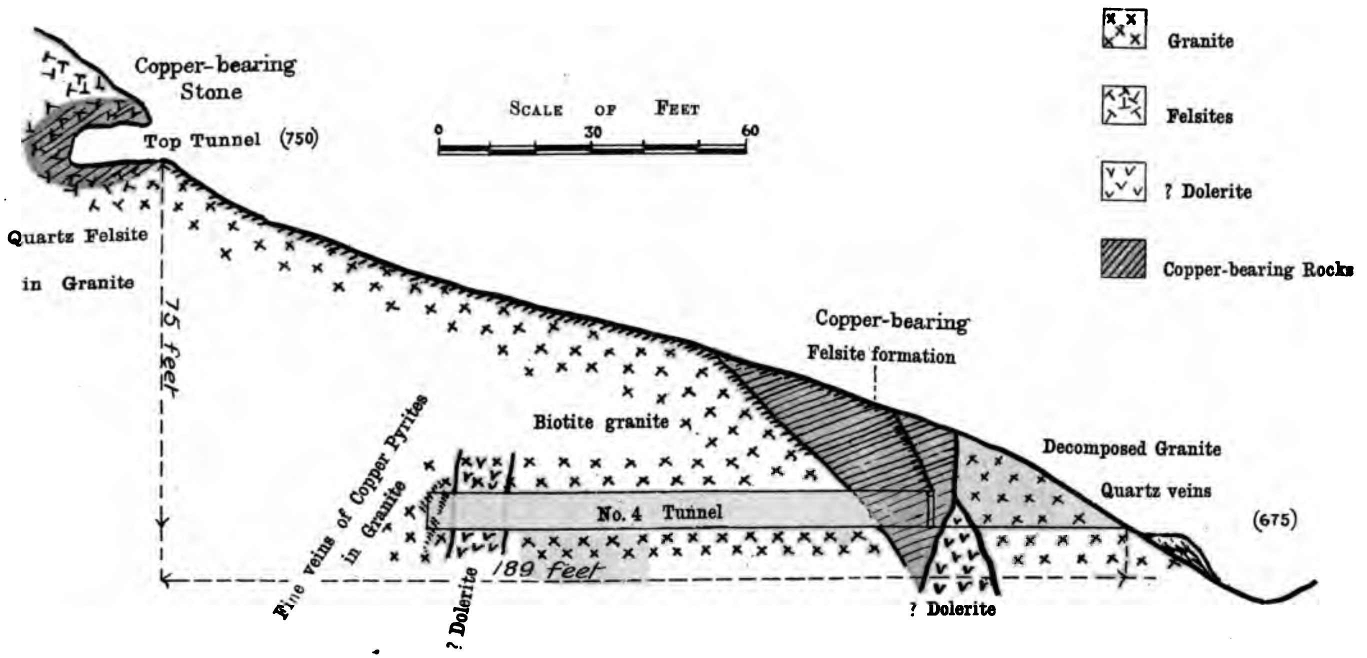


PLATE 4.

SECTION ALONG NO. 7 TUNNEL.

The section along No. 7 Tunnel exposes near the entrance a dyke of felsite with included quartzite fragments, and contained between walls of granite. Quartz with ankerite occurs in the dyke, and molybdenite with copper pyrites exists as fine veins and threads in the decomposed granite close by. A friable felspathic rock penetrated in the tunnel appears to be the same rock exposed on the crown of the hill just above it. Copper occurs in the outcrop on the hill, but has not been found in the tunnel. At the end of the tunnel threads of molybdenite make their appearance in the quartz felsites. Further references to No. 7 Tunnel are made on page 22.

Plate 4

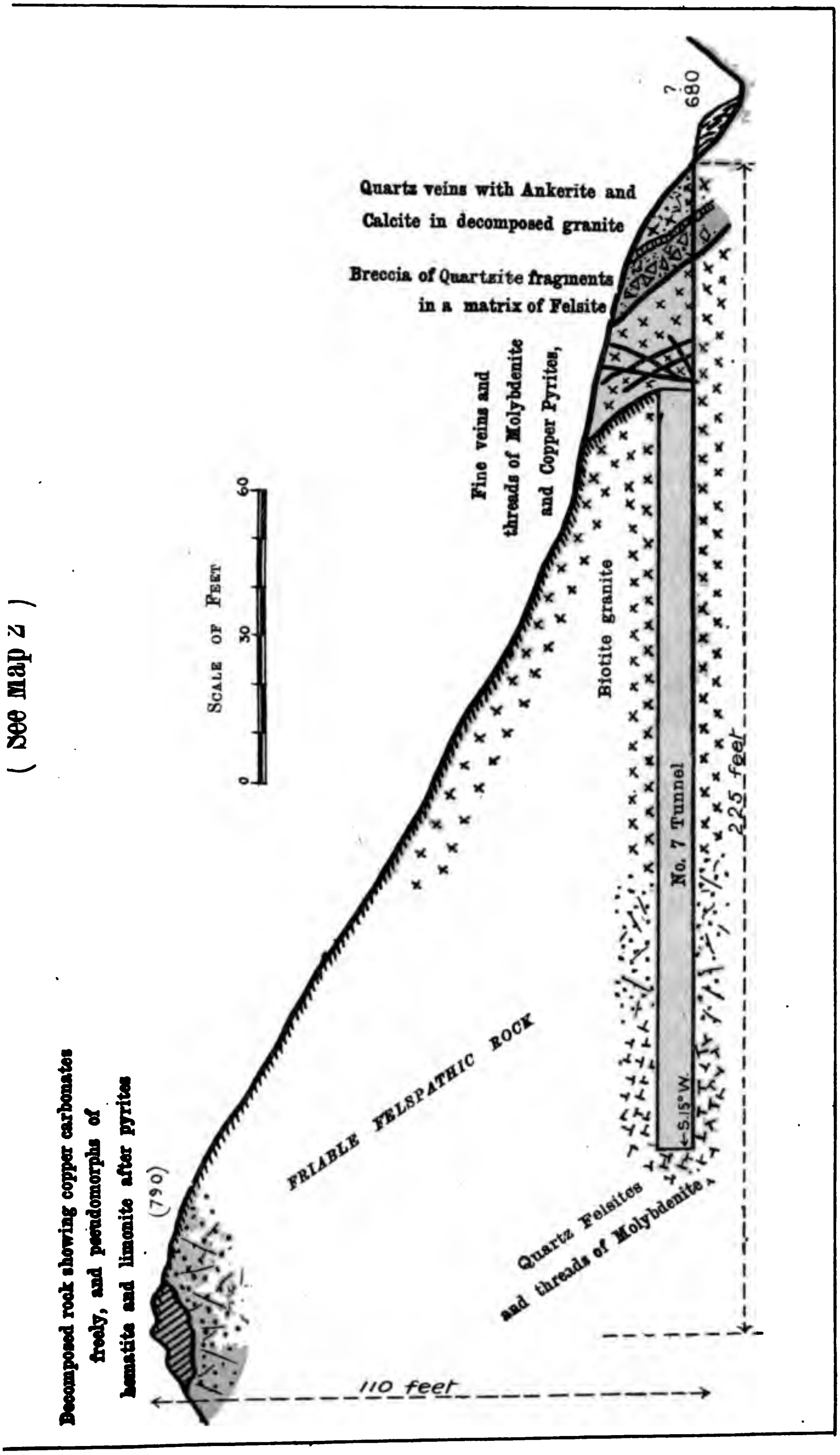

(See Map 2)
?
680
Quartz veins with Ankerite and Calcite in decomposed granite
Breccia of Quartzite fragments in a matrix of Felsite
Fine veins and threads of Molybdenite and Copper Pyrites,
Scale of Feet
0
30
60
Biotite granite
No. 7 Tunnel
S.15°W.
225 feet
FRIABLE FELSPATHIC ROCK
Quartz Felsites and threads of Molybdenite
(790)
Decomposed rock showing copper carbonates freely, and pseudomorphs of hematite and limonite after pyrites
110 feet

PLATE 5.

NO. 2 TUNNEL AND NO. 2 SHAFT.

The workings of No. 2 Tunnel and No. 2 Shaft are shown in plan and section. The copper-bearing formation lies between granite and felsites, and apparently has an easterly underlie. The cross-hatching represents the portion found to be copper-bearing stone, independently of the kind of rock containing the mineral. References to the copper contents of the workings are given on pages 20 and 21

EOLOGICAL SURVEY OF QUEENSLAND **Plate 5**

WORKINGS AT No. 2 TUNNEL AND No. 2 SHAFT

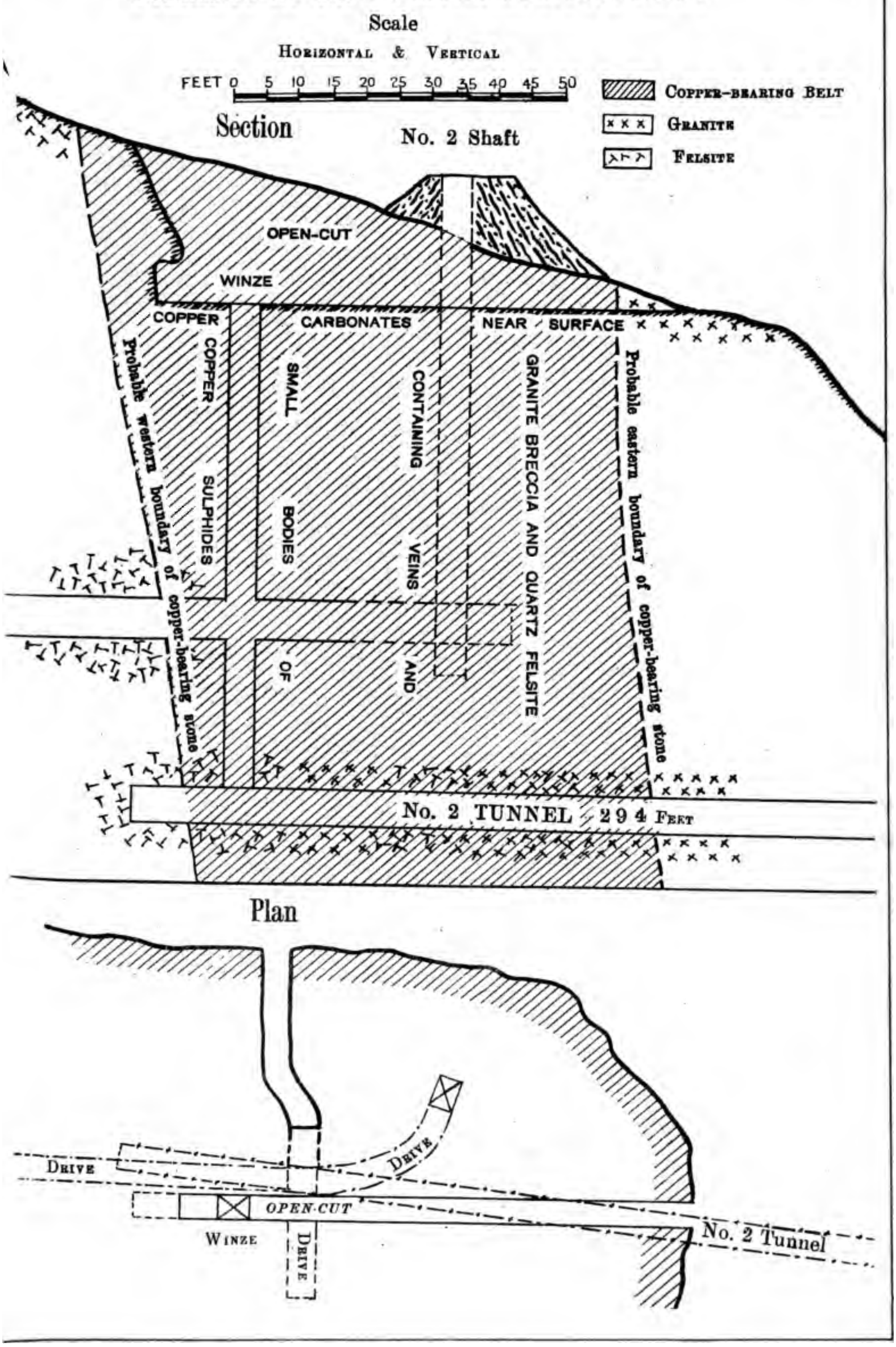


PLATE 6.

GEOLOGICAL SECTION FROM MOONMERA RANGE TO QUARRY.

The geological section from Moonmera Range to the quarry, along the line E F, on Map 2, illustrates the slightly-inclined Coal-Measure sandstones, shales, and tuffs, the steeply-inclined copper-bearing sandstones, and the felsite mass between the latter formation and the copper-bearing breccia further east.

Plate 6

GEOLOGICAL SECTION FROM MOONMERA RANGE TO QUARRY

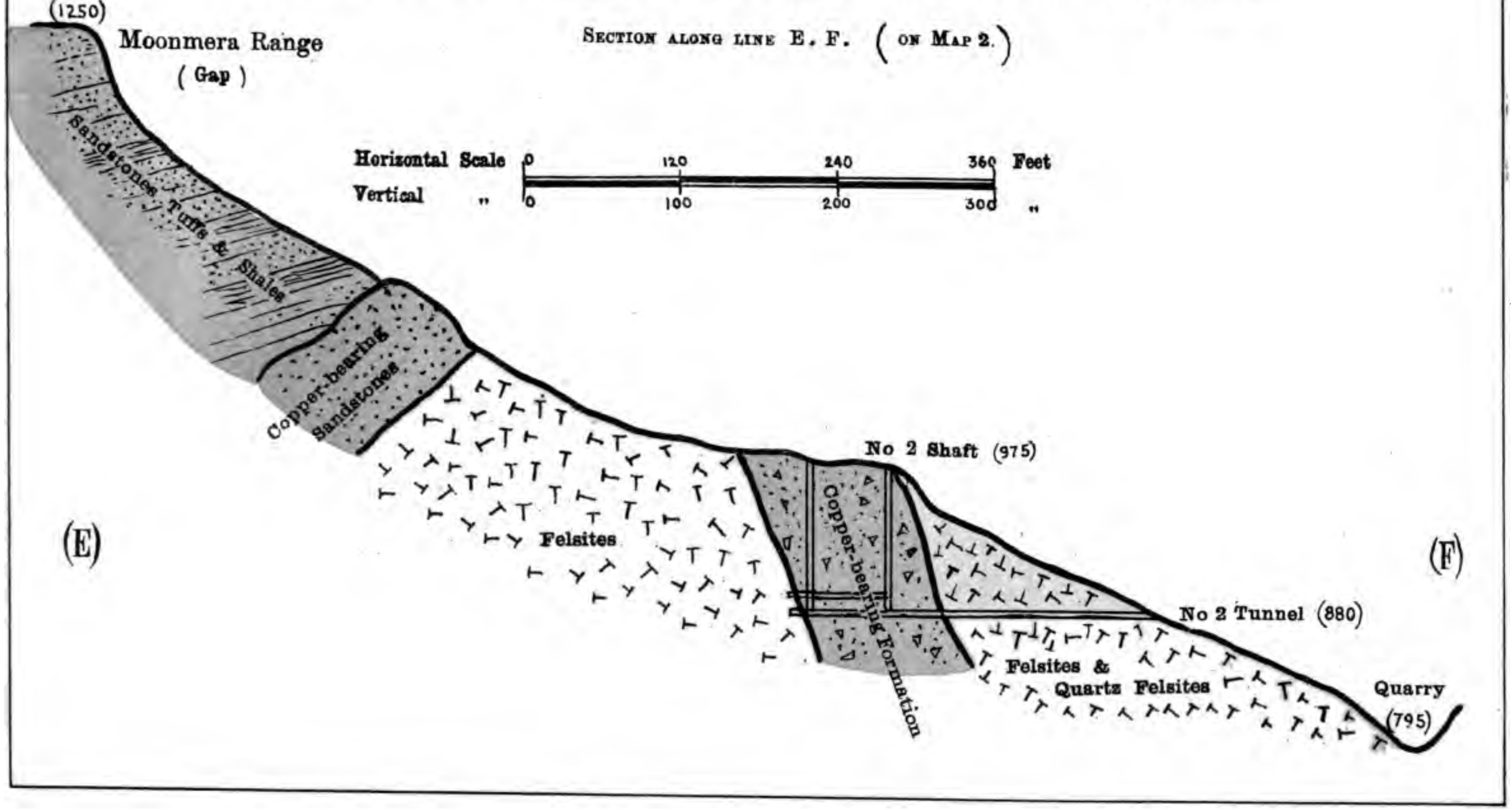

SECTION ALONG LINE E. F. (ON MAP 2.)
(1250)
Moonmera Range
(Gap)
Horizontal Scale 0 120 240 360 Feet
Vertical " 0 100 200 300 "
Sandstones, Tuffs & Shales
Copper-bearing Sandstones
Felsites
No 2 Shaft (975)
Copper-bearing Formation
No 2 Tunnel (880)
Felsites & Quartz Felsites
Quarry
(795)
(E)
(F)

PLATE 7.

a

SECTION EAST OF MOONMERA RANGE.

Section along the line G H, on Map 2, between South Peak and No. 3 Shaft. It shows the steep angles at which the irregular cupriferous sandstones are inclined to the west, and also the less inclined overlying Coal Measures.

A White tuffs.
B Sandstones.
C Shales with coal.
D Copper-bearing sandstones.
E Felsites.

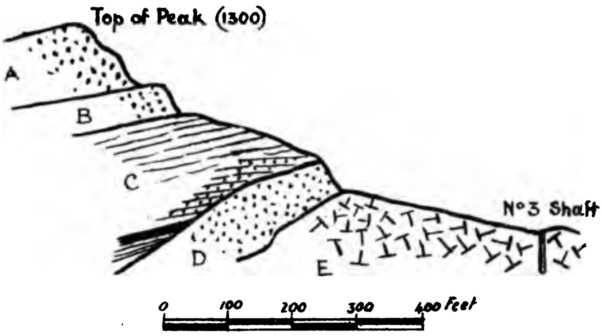
b

BRECCIA AT NO. 5 SHAFT.

A section of breccia from No. 5 Shaft, showing the angular and sub-angular fragments of a bluish quartzite (*b*) in a matrix of felsite (*a*). A microscopic section showed the quartzite to be made up of fragments much altered and of varying degrees of fineness, and to contain magnetite dust.

Scale: 1 inch = 6 inches.

(*a*)



(*b*)

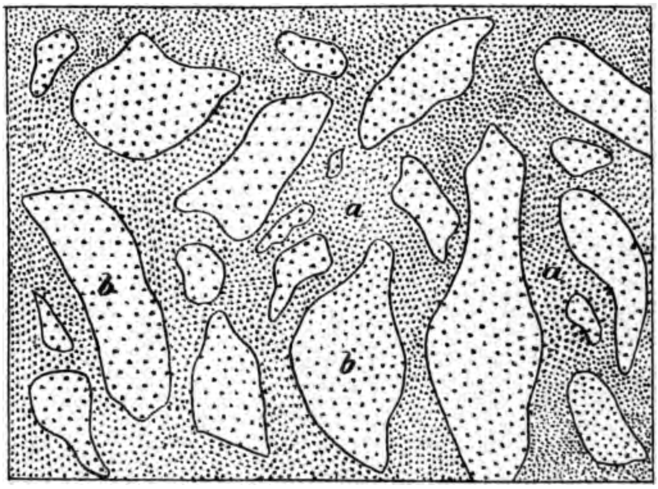


PLATE 8.

SECTION FROM RAILWAY CUTTING (A).

In this section large and small dykes of diorite have penetrated what is probably a broken-up mass of felsite included in a larger mass of diorite. A vein of fine-grained aplite and granite has been formed in the diorite and felsite.

Mica and hornblende occasionally occur in the diorite and felsite.

The horizontal diorite masses would appear to have been previously connected with one another, but taken in conjunction with the section (A) illustrated on Plate 15, it is evident that an open fissure in the felsite was formed, subsequently faulted, and then filled with diorite.

Scale: 1 inch = 12 feet.

Plate 8

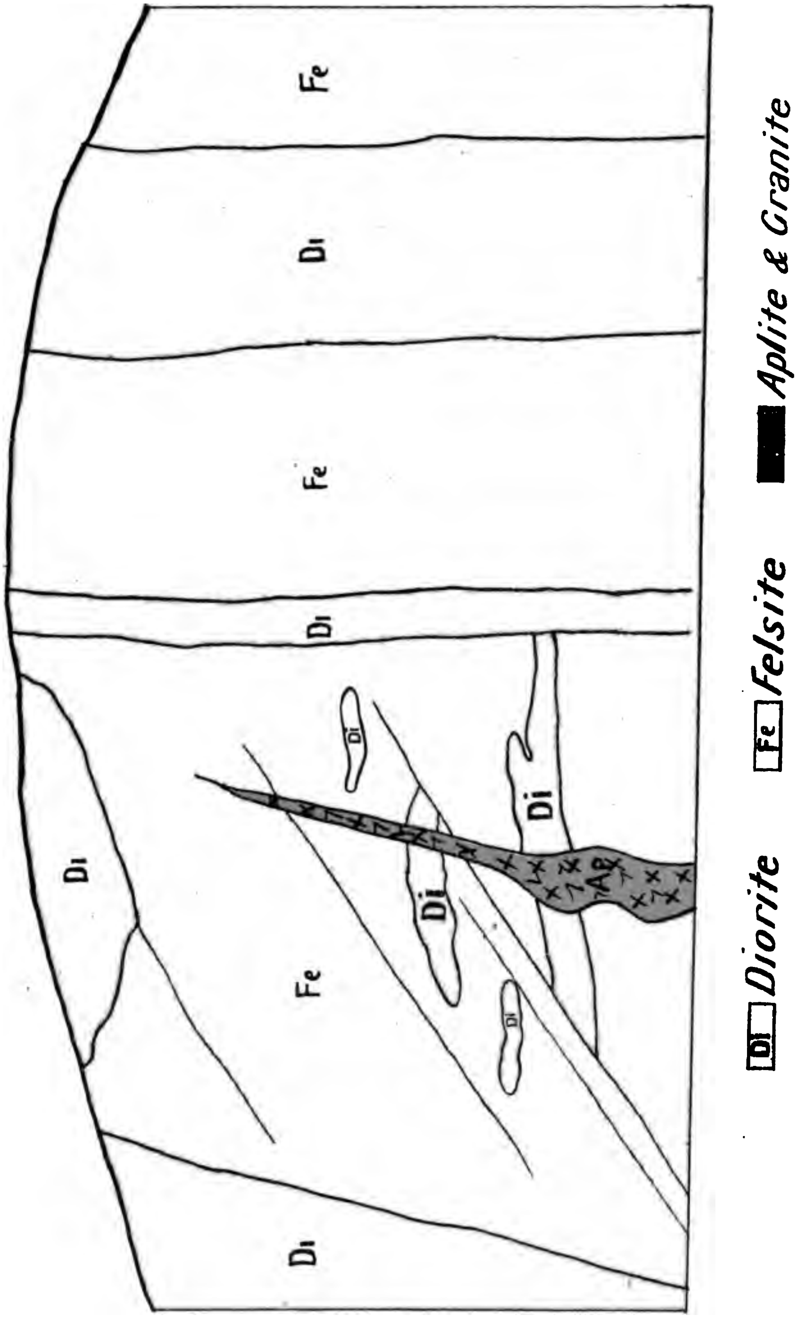

Fe
Di
Fe
Di
Di
Fe
Di
Di
Di
Di
Di
Di
Ap
Di Diorite
Fe Felsite
Aplite & Granite

PLATE 9.

SECTION FROM RAILWAY CUTTING (A).

An enlarged view of the aplite and granite vein shown on Plate 8. The section illustrates the system and joints in the felsite and the silicification of the felsite where it comes in contact with the aplite and granite. The silicification, however, is not limited to where the two rocks are in contact, as it occurs along some of the joints (shown dotted) in the felsite.

The aplite is fine-grained in places, almost felsitic, but also occurs of a coarse-grained texture and graduates into a vermiculite granite.

Plate 9

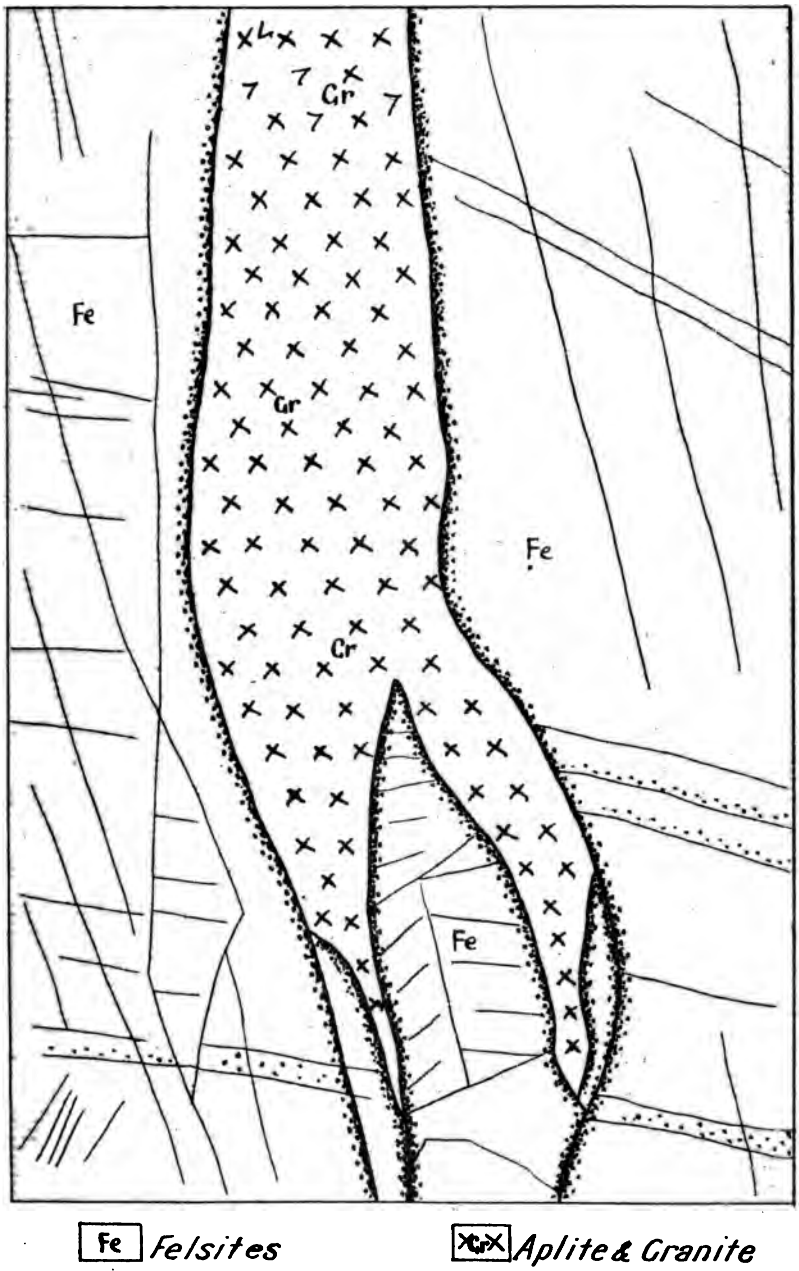


PLATE 10.

a

SECTIONS IN RAILWAY CUTTING (B).

A felsite mass in the railway cutting (B), shown on Map 1, has been intruded by a diorite dyke. Subsequently the two rocks, as one mass, have been faulted, and in the resulting fissure an aplite has been formed, this rock graduating into a clean quartz in the smaller parts of the vein.

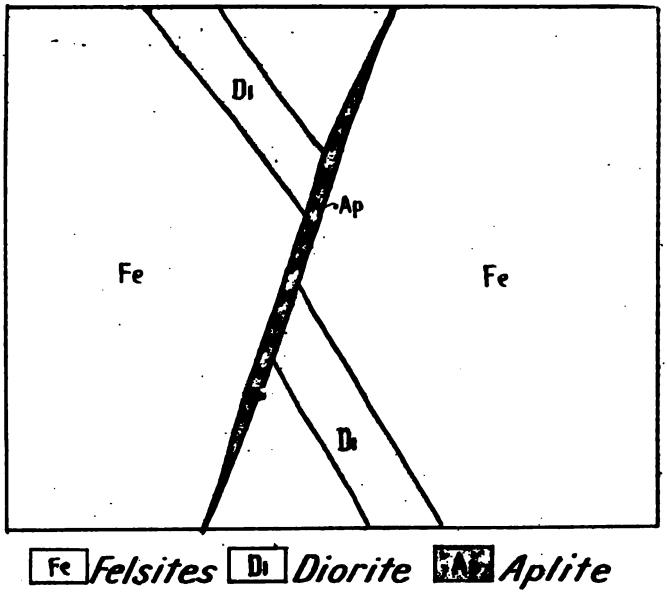
Scale: 1 inch = 8 inches.

b

Aplite and pegmatite granite veins have been formed in the massive syenite, across both of which a series of small veins of aplite has more recently been formed.

Scale: 1 inch = 14 inches.

(a)


Di
Ap
Fe
Fe
Di
Fe Felsites
Di Diorite
Ap Aplite

(b)

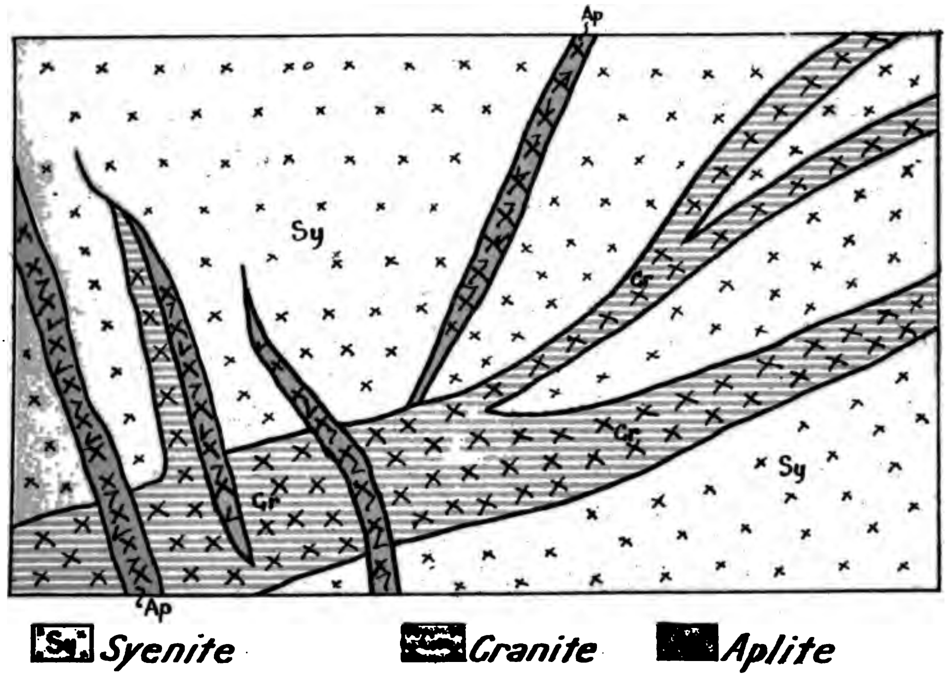

Ap
Sy
Gr
Gr
Gr
Sy
Ap
Sy Syenite
Cranite
Aplite

PLATE 11.

SECTION IN RAILWAY CUTTING (B).

In this section the diorite (Di.) has been faulted, and a mass of vermiculite granite (Gr.) has been formed in the fissure. Across the diorite and granite some veins of aplite (Ap.) and quartz have been subsequently formed.

Scale: 1 inch = 3 feet.

GEOLOGICAL SURVEY OF QUEENSLAND

Plate 11

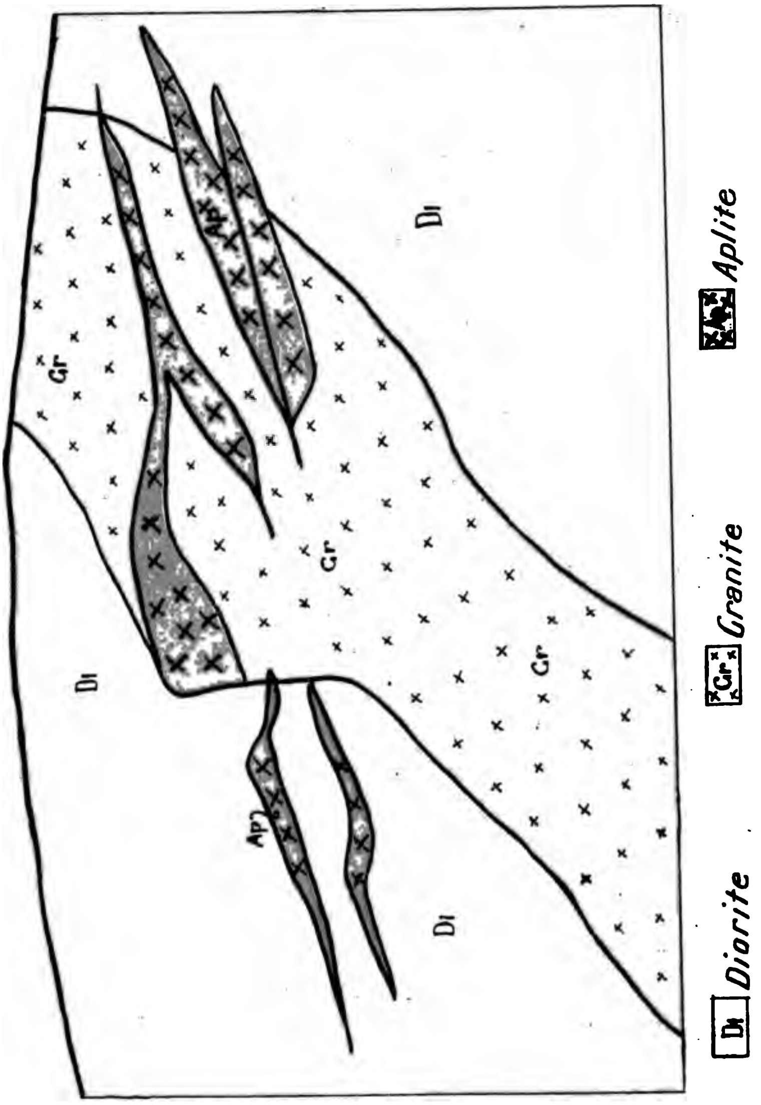


PLATE 12.

SECTION IN RAILWAY CUTTING (C).

In this section the massive fine-grained granite has been broken up into blocks, and faulted along the joint planes. The character of the faulting and the formation of short gashes show that the granite has not been in a rigid condition.

The veins of the vermiculite granite are probably the equivalent of the granite in the section on Plate 11, while the massive rock would be the equivalent of the oldest (*a*) granite. (*See* Plate 19.) The vermiculite granite is coarse-grained. Under the microscope the felspar is seen to be decomposed, and while some of the mica, evidently undecomposed biotite, is strongly pleochroic and coloured green, other portions are not pleochroic and are coloured deep brown.

Scale: 1 inch = 6 feet.

Plate 12

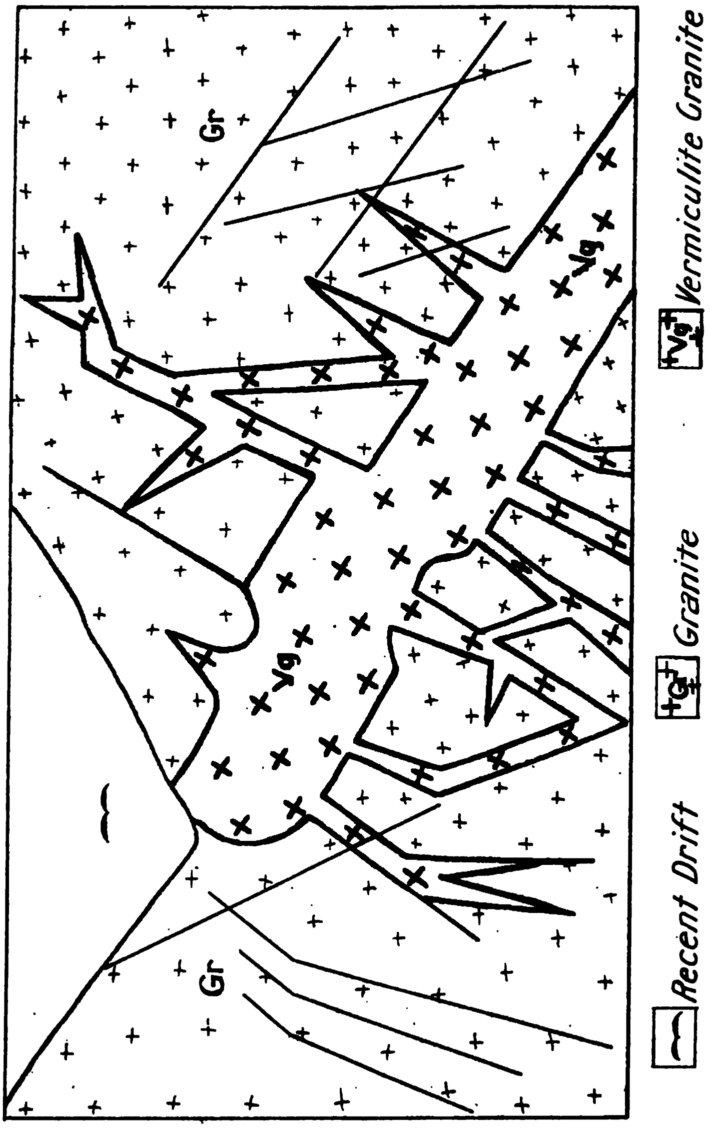


PLATE 13.

a

SECTION BETWEEN RAILWAY CUTTINGS (E) AND (F).

The section indicates that, without any apparent faulting, an opening has been made in the syenite in which a 6-inch vein of coarse pegmatite granite has formed. The branch fissure appears to have originated simply by the widening of a crack, the irregularities in the top and bottom walls showing they were once in contact.

Scale: 1 inch = 14 inches.

b

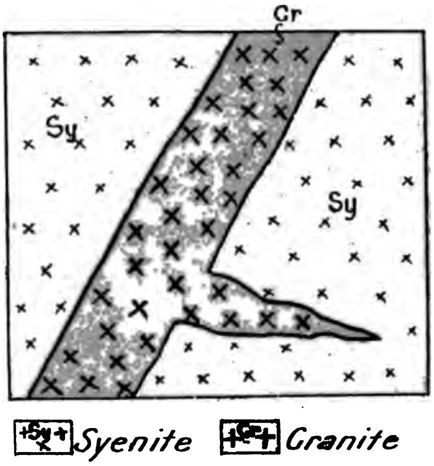
SECTION IN RAILWAY CUTTING (F).

A diorite has been dislocated, and in the fissures which have been opened veins of fine-grained biotite (*b*) granite—marked Gr. 2—have been formed. Afterwards the diorite and the veins of fine-grained granite have been disturbed and faulted, and the opening made has been filled with a vein of coarse-grained (*c*) vermiculite granite (marked Gr. 3).

To produce the effect shown in the illustration—the faulting of one of the veins of the granite (Gr. 2) apparently without the other—the later faulting has taken place at an angle with the plane of section, being approximately along the direction of the strike of the branch vein inclined to the left, this also being along the direction of dip of the vein inclined to the right.

Scale: 1 inch = 5 inches.

(*a*)


Gr
Sy
Sy
Sy
Syenite
Gr
Granite

(*b*)

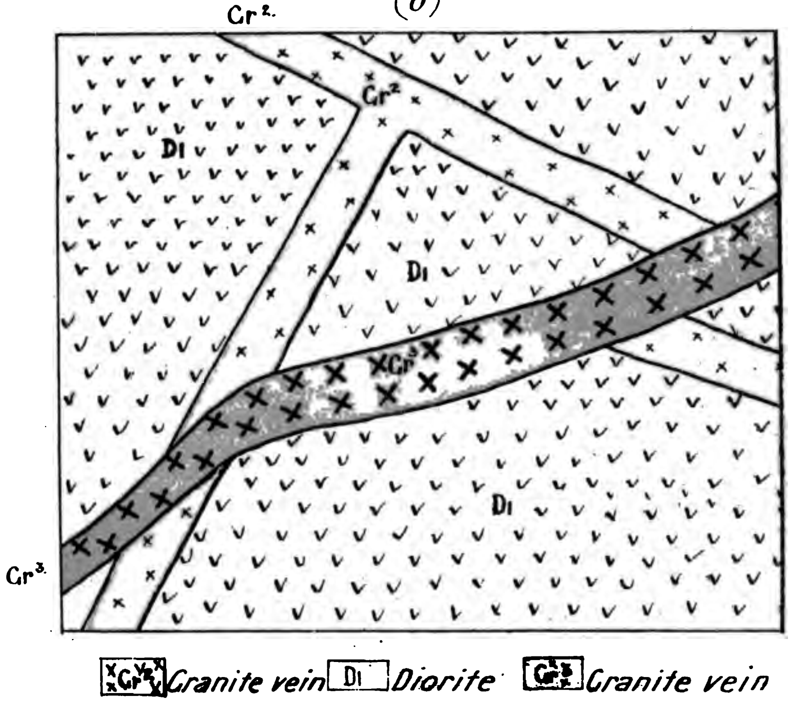

Gr².
Gr²
Di
Di
Gr³
Di
Gr³.
Gr² Gr³
Granite vein
Di
Diorite
Gr³
Granite vein

PLATE 14.

SECTION IN RAILWAY CUTTING (F).

A diorite (Di.) has enveloped a "horse" of felsite (Fe.), and across the felsite and diorite some vermiculite (*c*) granite veins—marked Vg.—have been formed. The shape of the veins of granite shows that openings had been made in the diorite, and that (*c*) granite subsequently filled them—the granite being an ***after effect*** of the disturbance of the diorite.

Scale: 1 inch = 1 foot.

Plate 14

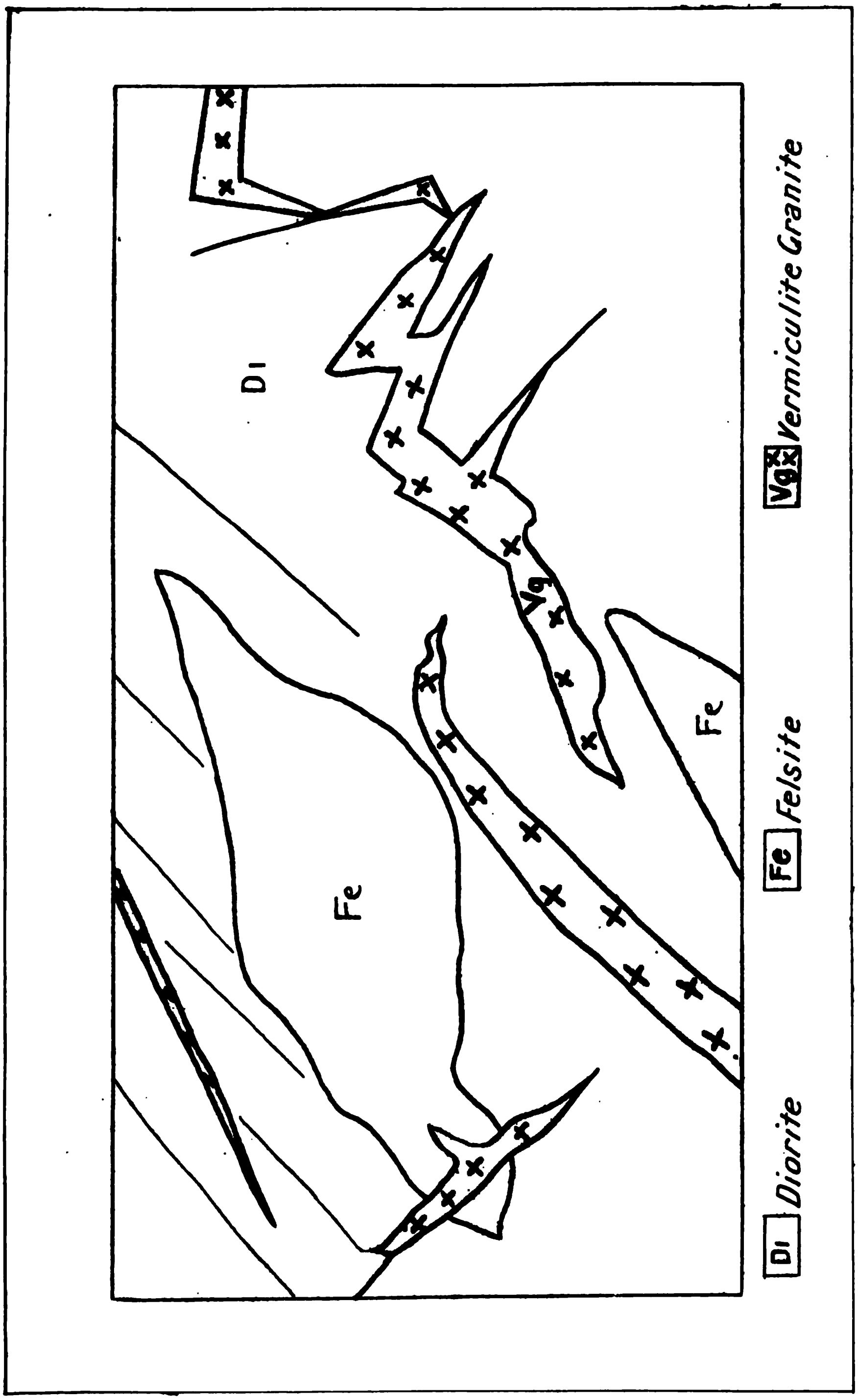


PLATE 15.

a

SECTION IN RAILWAY CUTTING (G).

The diorite (Di.) has penetrated a fault in a large inclusion of felsite (Fe.). The faulting took place at an angle with the plane of section, and the upper portion (*a*) of the felsite has moved forward over the lower portion (*b*).

Scale: 1 inch = 18 inches.

b

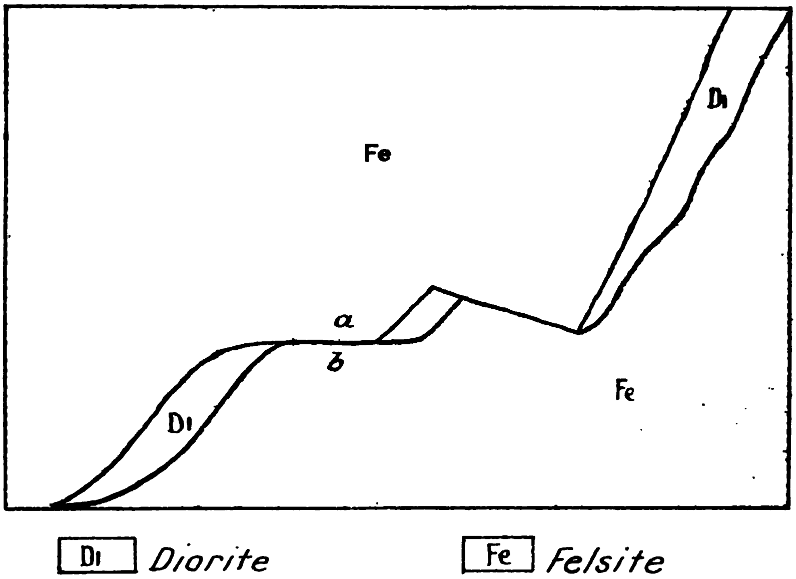
SECTION IN RAILWAY CUTTING (G).

The section represents a vein of (*c*) vermiculite granite—marked Gr.—in the diorite (D). The contact of the granite and the diorite is sharply defined, and the junction of the two veins well shown. In the branch vein trending to the left the granite changes gradually to aplite (Ap.) and vermiculite pegmatite, the aplite being near the walls and the pegmatite along the centre.

Scale; 1 inch = 1½ inches.

Plate 1

(*a*)


Fe
Di
a
b
Di
Fe
Di Diorite
Fe Felsite

(*b*)

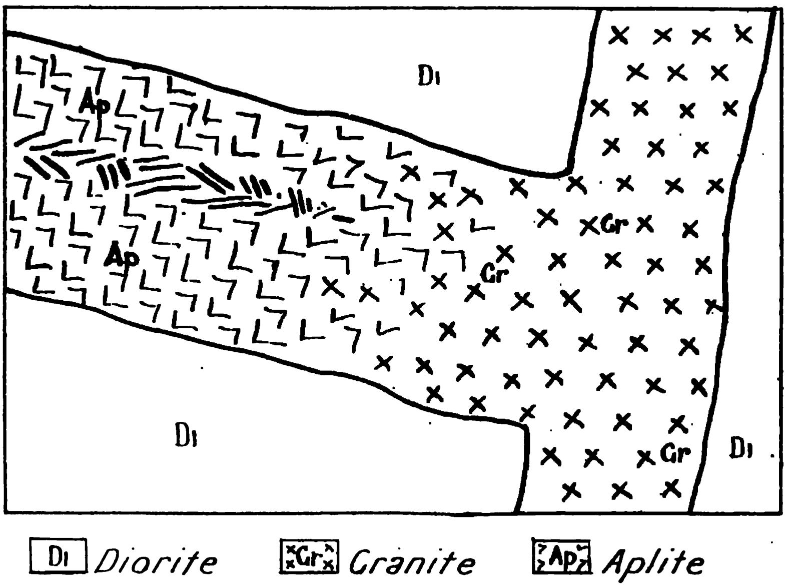

Di
Ap
Ap
Gr
Gr
Gr
Di
Di
Di Diorite
Gr Granite
Ap Aplite

PLATE 16.

SECTION IN RAILWAY CUTTING (G).

In this section a mass of quartz-felsite (Q. Fe.) has been faulted, and the resulting fissure has been filled with a friction breccia.

Diorite (Di.) was then forced through the line of fault, forming small subsidiary horizontal offshoots in the quartz-felsite, and leaving the breccia on the footwall.

Subsequently a vein of fine-grained (*b*) or (*c*) granite—marked Gr. in the section—has formed across the diorite and the older rocks, the final stage being the simple dislocation of the formations, along the plane of which, and as the result of expansion and contraction, movements may now be taking place. On either side of this joint plane the rocks are compact and well cemented together.

Scale: 1 inch = 5 feet.

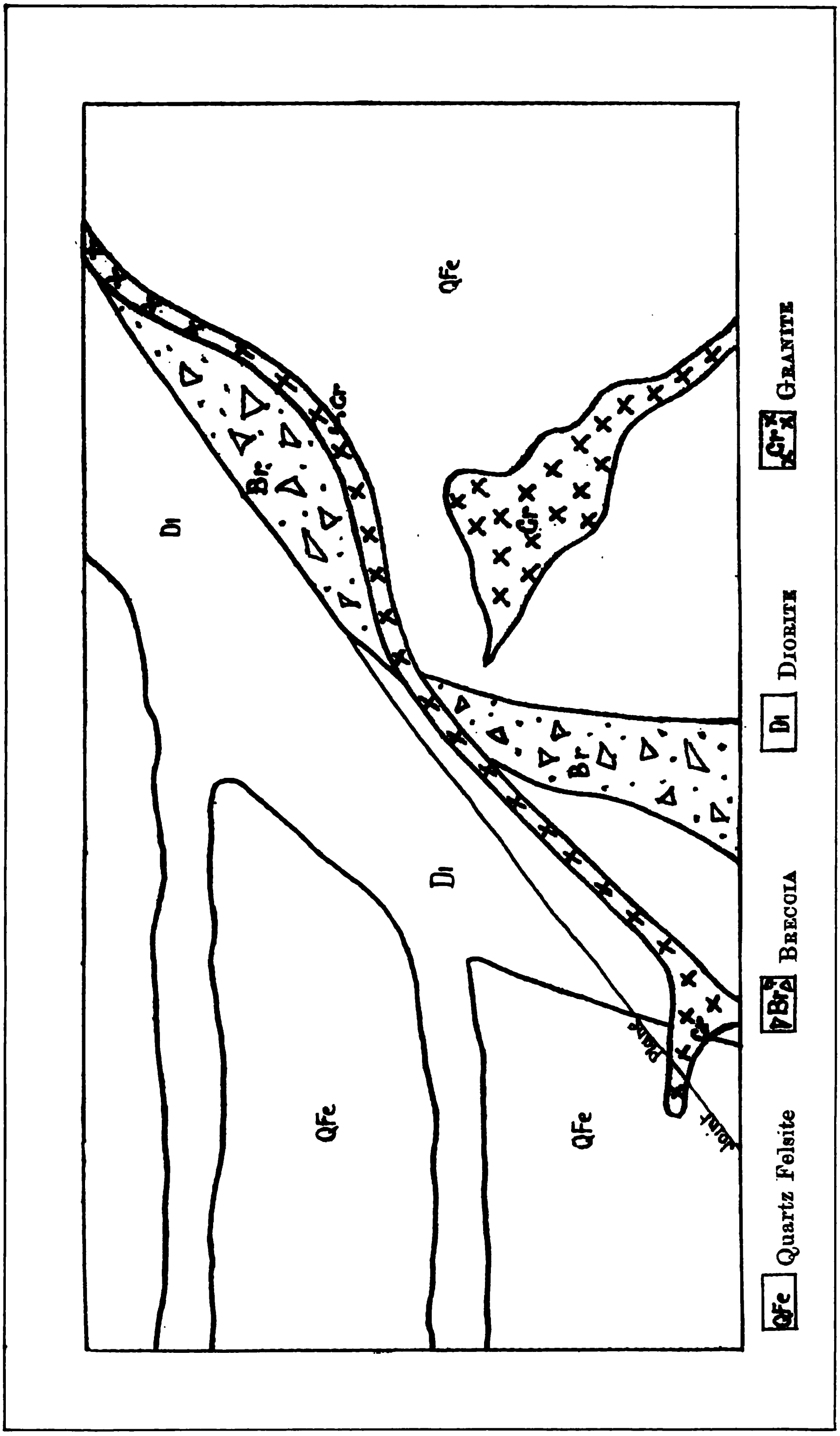

QFe
Di
Br
Gr
Br
Di
QFe
QFe
Joint Plane
Gr
QFe Quartz Felsite
Br Breccia
Di Diorite
Gr Granite

PLATE 17.

a

SECTION IN RAILWAY CUTTING (G).

The diorite in this section contains a vein of (*b*) vermiculite granite—marked Gr.—across both of which some leaders of (*c*) aplite and micro-pegmatite have been formed. The section is in some respects similar to the one shown on Plate 13, Fig. (A), but in the latter biotite is present.

Scale: 1 inch = 12 inches.

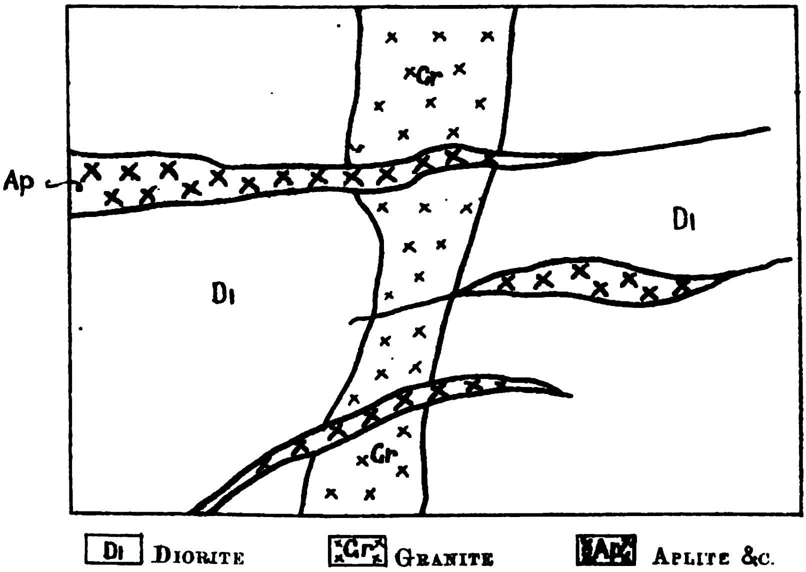
b

SECTION IN RAILWAY CUTTING (G).

A vein of (*c*) aplite has formed across both diorite and the quartz-felsite. The aplite is fine-grained, but occasionally large flakes of vermiculite mica are to be seen in it. The vein is wide in the diorite, and gradually pinches out in the quartz-felsite. The gradual tapering of the walls of the vein indicate the diorite and quartz-felsite to have the same degree of plasticity at the time the fissure was opened across them.

Scale: 1 inch = 2 feet.

(*a*)


Gr
Ap
Di
Di
Gr
Di Diorite
Gr Granite
Ap Aplite &c.

(*b*)

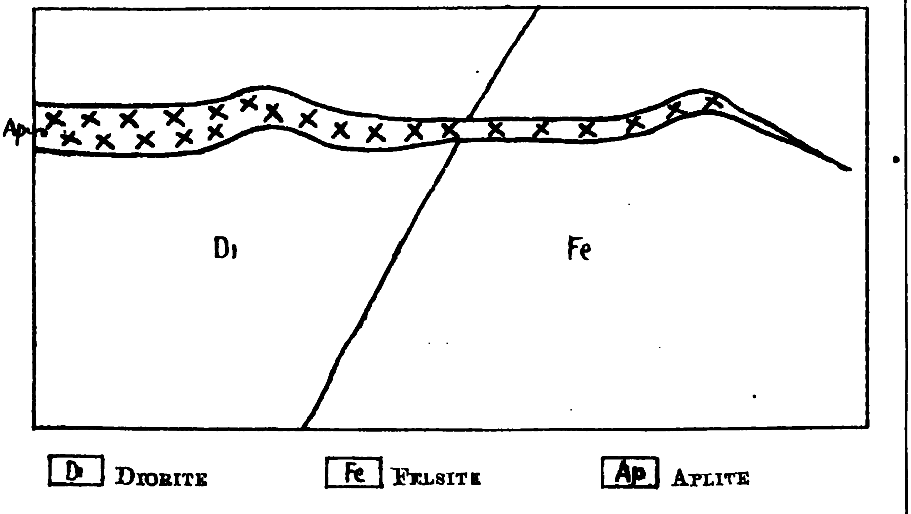

Ap
Di
Fe
Di Diorite
Fe Felsite
Ap Aplite

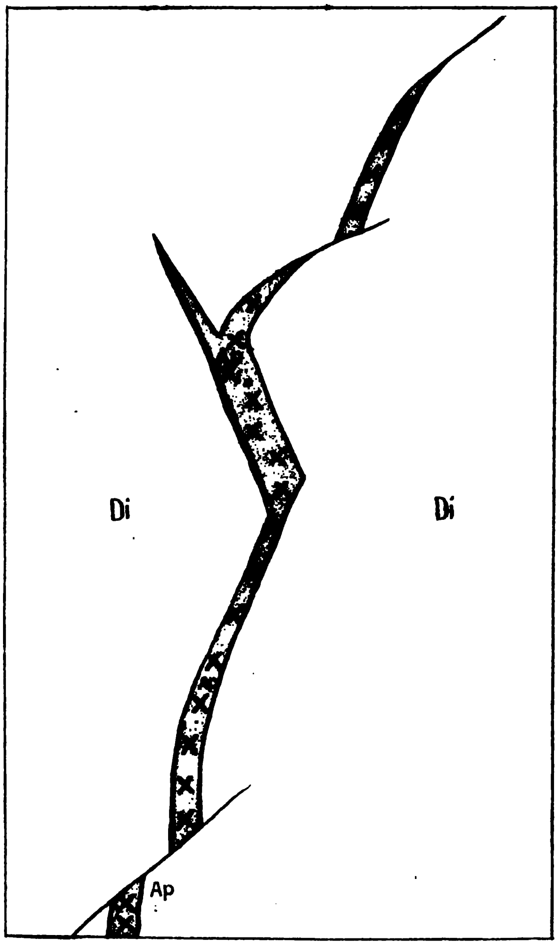
PLATE 18.

SECTION IN RAILWAY CUTTING (G).

In the diorite a fissure has been opened, and then filled with a vermiculite granite. The section illustrates an apparent dislocation of the granite vein, but the faulting is only apparently so, the diorite being disturbed and the fissure produced before the granite came into existence. The section indicates that the diorite was sufficiently plastic to allow some portions to be extended without fracture—otherwise such a section would be impossible. The section is not uniformly to scale, but it shows all the salient points.

The same effect appears to have taken place in the quartz-felsite as well as in the diorite shown in Fig. *b*, Plate 17.

Scale: 1 inch = 14 inches (approx.).



Di *Diorite* ▨ *Aplite*

PLATE 19.

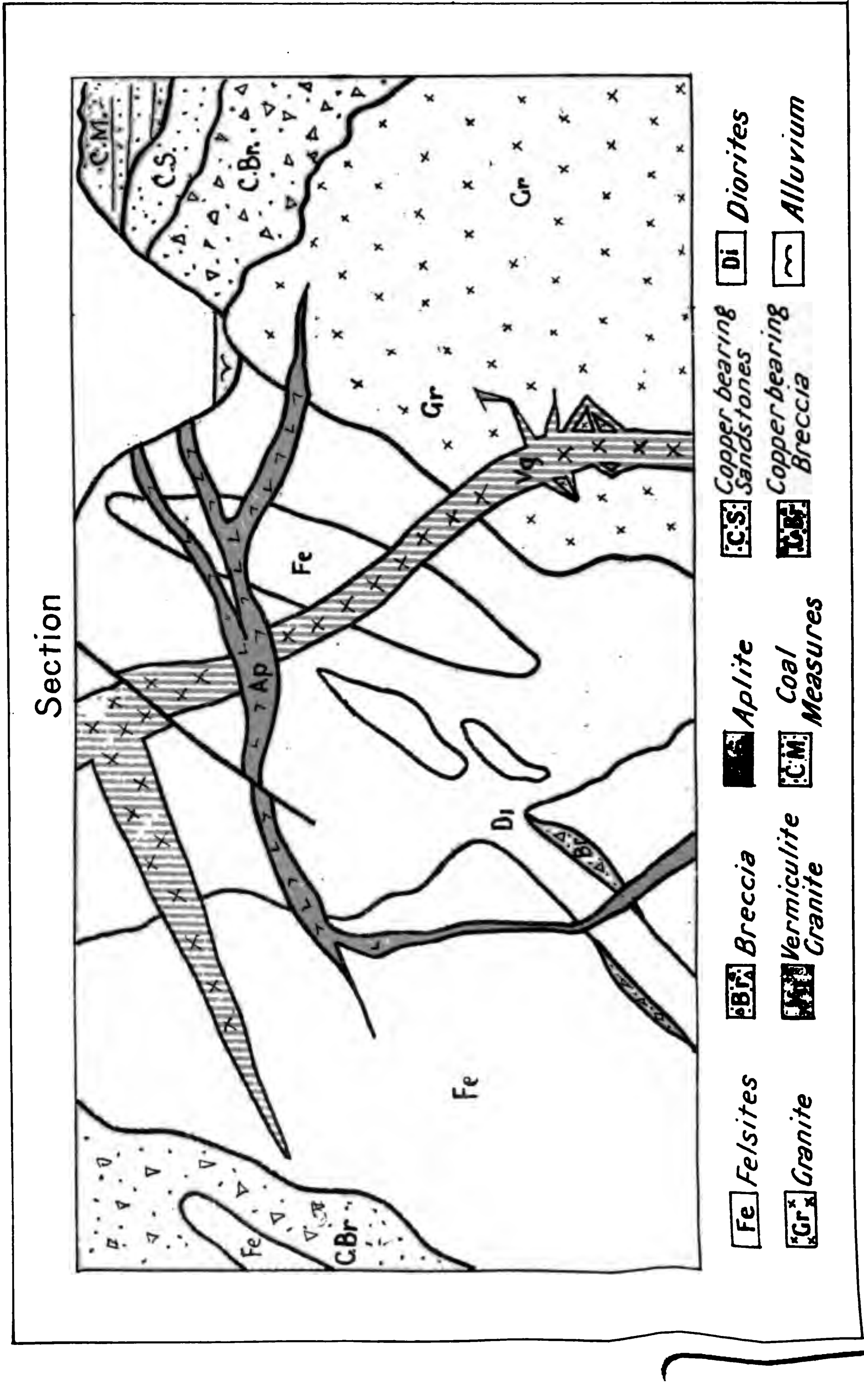
DIAGRAMMATIC SECTION.

This illustration is a key or diagrammatic section showing the relation of the systems of rocks to one another at Moonmera.

The granite and syenite (Gr.) and felsites (Fe.) are the oldest rocks, the relation to one another not being known. Faults in the felsites have been formed, and in this a breccia (Br.) has accumulated. Another breccia (C. Br.), copper-bearing, and very massive, has formed above the granite. The diorite (Di.) dykes penetrate the felsites and disturb the breccia, but their intrusion of the old (*a*) granite and syenite has not yet been observed. The intrusion of the felsites by diorite has resulted in portions of the former rock being detached and included in the latter.

Since the diorite intrusions some veins of vermiculite (*b*) granite—marked Vg.—have come into existence in the massive (*a*) granite and syenite, and in the diorite and felsites. Veins of (*c*) aplite and pegmatite—marked Ap.—have formed across the (*b*) granite veins and the older rocks, and then were faulted. The copper-bearing breccia and granite have been denuded in places, resulting in the accumulation of a surface deposit of irregular copper-bearing sandstone (C. S.), and on which the Coal-Measure rocks (C. M.) have been deposited. Weathering of the Coal Measures above, and of the granite, syenite, diorite, felsites, and breccia below, have then taken place, and is in progress at the present time, while alluvial deposits containing gold have been concentrated in the watercourses leading down from the high country.

GEOLOGICAL SURVEY OF QUEENSLAND Plate 19



Section

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(WITH MAP.)

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